New York

SALARIES

Page 244

Chemical Engineering

JULY 1955



Evaluate your future . . .

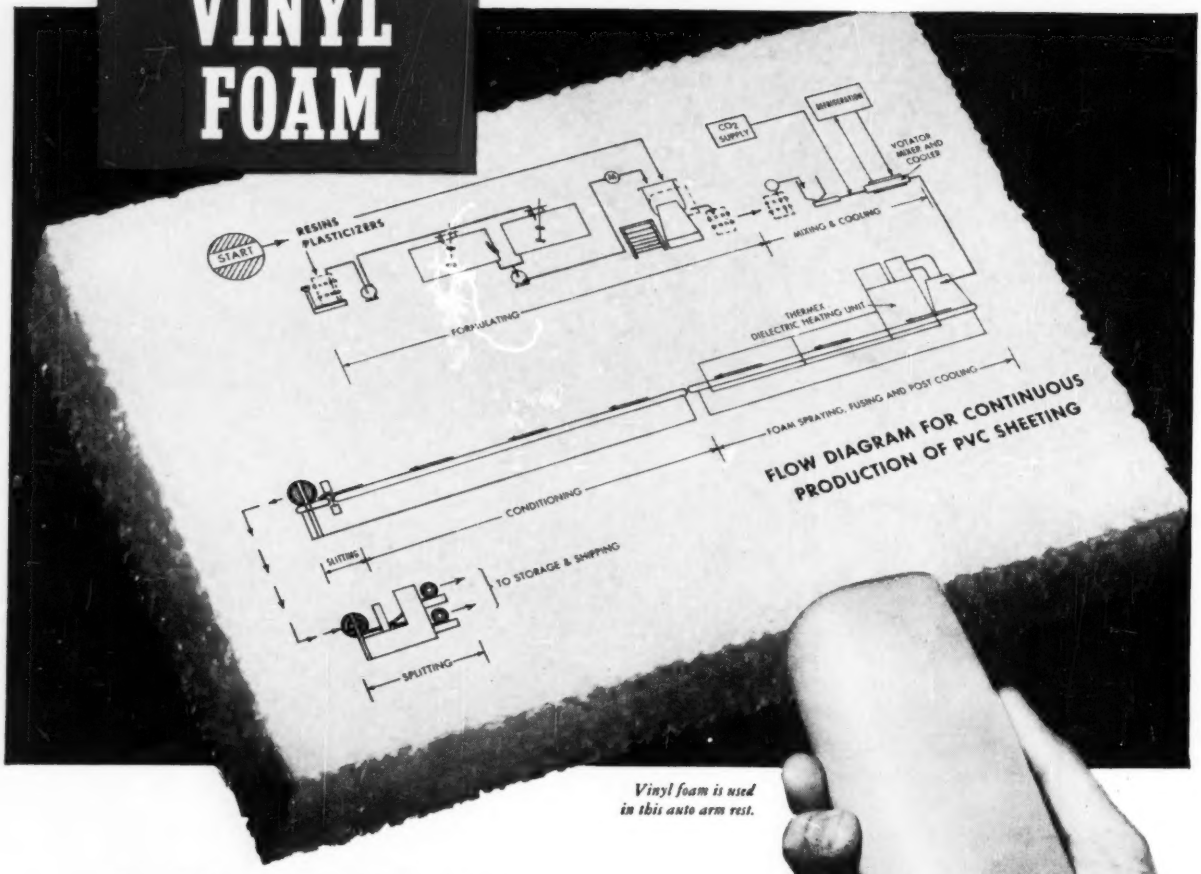
MOVING-BED PROCESSES

A big part of tomorrow's chemical engineering is packed into our 32-page CE Report. It's timely, complete, authoritative.

A McGRAW-HILL PUBLICATION

ONE DOLLAR

VINYL FOAM



Vinyl foam is used in this auto arm rest.

Another new era of improved products aided by

Votator® PROCESSING APPARATUS

Vinyl foam, now out of the pilot plant and into mass production, is bringing important advantages to many products. Here is another great achievement of American industry in which engineers of Girdler's Votator and Thermex Divisions have made vital contributions.

The flow chart shows the basic elements of a system for the continuous production of polyvinyl chloride foam sheeting. This versatile system, in which the Elastomer Process† is widely and advantageously employed, makes possible the use of many resins and plasticizers for the manufacture of open-cell flexible vinyl foam in a broad range of resiliences. It is used for both flat stock and molded articles.

In this system, VOTATOR* Processing Apparatus mixes and cools the vinyl on a continuous basis and delivers it at the right temperature and consistency, ready for spraying or molding.

Many processing functions are performed with VOTATOR Heat Transfer and Mixing Apparatus. Find out how it can help *you* in the development of *new* products and in the *improvement* of existing products. Call our nearest office or write for a copy of the Votator Data Book.

†Licensed by Elastomer Chemical Corporation

*VOTATOR—Trade-Mark Reg. U. S. Pat. Off.

the GIRDLER Company

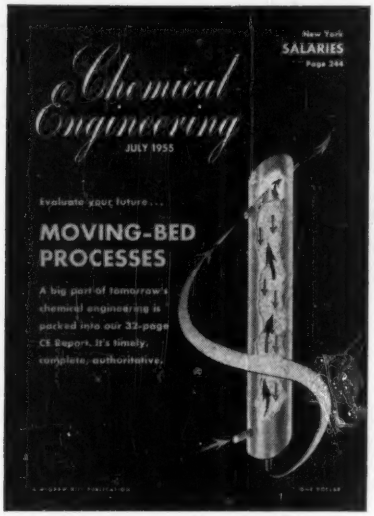
A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

VOTATOR DIVISION: New York, Atlanta, Chicago, San Francisco
GAS PROCESSES DIVISION: New York, San Francisco. IN CANADA: Girdler Corporation of Canada Limited, Toronto

GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



. . . **What's ahead for moving-bed methods in tomorrow's chemical technology.**

The answers are in this issue's 32-page report—is a comprehensive, interpretive survey of this fast-growing technique for contacting solids and gases. It covers fundamental principles, design features, commercial applications, recent improvements, comparative advantages and limitations. This study, on which the author worked for over five months, fills a need long felt by chemical engineers in industry. (p. 175)

Variable speed for process control.

Simple and low in cost: that's why you'll be hearing more about automatic process control by a constant-speed motor and variable-speed mechanical devices. Here's an evaluation of the whole field. (p. 215)

Engineering your cost reductions.

Monsanto tells how to cut operating costs by ingenious engineering approach to budget, production control and cost reduc-

Please turn page

3.7 Times 'Round the Globe

Last year CE's engineer-editors piled up more than 92,300 miles of out-of-town travel. Converted to a useless statistic, that's equivalent to 3.7 times around the equator!

These out-of-town trips—largely to plants, engineering offices and development laboratories—covered 91 principal processing areas or cities in 38 states.

Major areas were visited often: Five of us spent a total of 14 days in and around Cleveland, 11 of us spent 20 days in the Philadelphia-Wilmington area—and so on.

Of course there were many other trips of a day or less in the vicinity of our four principal editorial offices in New York, Chicago, San Francisco and Houston.

Through travel we learn about industry development at their source, uncover article ideas, develop news stories, work directly with our authors.

We also meet you, our readers, and find out first-hand what you do—and what you want us to do!—JRC



tion standards. It also improves the efficiency of production operations. (p. 207)

Select drives for heat balance.

Here's an analysis of engineering and economic factors in the selection of drives for heavy equipment. It'll also help you determine whether your drives should be motorized or steam driven. (p. 211)

Pump into a common pipeline?

You'll find it convenient to use this new graphical way to pinpoint the performance of any one of several pumps feeding into a common pipeline under any condition of the system. It's quick, accurate. (p. 223)

How Does your salary stack up?

Check your own pay against that of chemical engineers in New York. Just completed, this exclusive survey also shows what these men say about how well paid—or poorly paid—they are. (p. 244)

Rejoin* GUIDED TOUR *page 302

Chemical Engineering JULY 1955

CHEMENTATOR 103

WHAT'S HAPPENING IN CHEMICAL ENGINEERING

Made-To-Order Catalysts 112
Dry Ice and Super Dry CO_2 120
Cane Sugar by Continuous Diffusion 124
PVC by Suspension Polymerization 128
Triple Action Centrifuge 132

CHEMICALS & RAW MATERIALS

Acrylics and PVAc for Water Paint 140
Index to this month's new chemicals 142

FEATURE REPORT

A Lot of the Future 173
Moving Bed Processes 175
Raymond E. Vener
Commercial Operation 177
Fundamental Concepts 181
Engineering Design 189
New Applications 198

FEATURE ARTICLES

Engineering Your Cost Reduction 207
D. V. Bierwert and F. A. Krone
Plant Drives for Process Heat Balance 211
Thomas H. Anderson, Jr.
Variable Speed for Process Control 215
Richard Le Baron Bowen, Jr.
Rate Your Centrifugal Pumps—In Use 223
N. Sag

CE REFRESHER

Interpretation of Kinetic Data—IV 227
Thomas E. Corrigan

PLANT NOTEBOOK

Automatic Delay for Burner Control 232
Joseph R. Wilson

Truck Transmission Drives Conveyor 234
Carl L. Murray

Mark Charts for Normal Conditions 234
Thomas Garcia B.

Thermal Conductivity Chart for Gases 236
Om P. Kharbanda

Aids for Pressure Drop Calculations 238
J. R. LaPointe and G. G. Nahay

How to Acidize a Water Well 240
W. F. Knighten, Jr.

YOU AND YOUR JOB

How Does Your Salary Stack Up? 244

CORROSION FORUM

Versatile New Alloy Now Available 256

TOMORROW'S TECHNOLOGY

Unstable Solids Dried Fast 264
Now, a Pebble Cooler 266
Your Checklist of New Patents 270

EQUIPMENT NEWS

New Non-Metallic Shapes 274
Index to this month's new equipment 276
Equipment Cost Index 276
Vary Film in Thermal Process 278

CHEMICAL ECONOMICS

Chemicals Will Decentralize 294
Henry Wessel

Consumption Index 296
Soda Ash Target: 6 Million 298
Robert C. Miller

PICTURED FLOWSHEET

Ammonium Nitrate—3 Processes 320

OTHER DEPARTMENTS

Advertisers Index 452
Book Reviews 340
Convention Calendar 134
Firms in the News 346
Man of the Month 327
Names in the News 328
New Technical Literature 422
Pro and Con 336
Reader Service 467
Recent Pamphlets 344

CHEMICAL ENGINEERING

July, 1955 Vol. 62—No. 7

Publisher ..... Wallace F. Traendly
Editorial Director ..... Sidney D. Kirkpatrick

Editor ..... John R. Callaham
Managing Editor ..... Lester B. Pope
Senior Associate Editor ..... Theodore R. Olive
Senior Associate Editor ..... Cecil H. Chilton
Associate Editor ..... Calvin S. Cronan
Associate Editor ..... Morgan M. Hoover
Assistant Editor ..... Donald R. Cannon
Assistant Editor ..... Raymond F. Fremed
Assistant Editor ..... Robert B. Norden
Assistant Editor ..... Hugh T. Sharp
Assistant Editor ..... Edward T. Thompson
Editorial Assistant ..... Roslyn K. Gitlin
Art Editor ..... Margaret Redfield
Midwest Editor ..... Frank C. Byrnes
Southwest Editor ..... James A. Lee
Western Editor ..... Elliot Schrier
Washington Editor ..... F. W. Olcott
Economics Editor ..... William H. Chartener
Reader Service Editor ..... Alvin J. Babkow

Advertising Director ..... R. S. Muller
Advertising Sales Manager ..... S. J. Shaw
Business Manager ..... A. J. Mangold
Sales Promotion Manager ..... E. A. Atwood, Jr.
Market Service Manager ..... Adolph I. Losick
Sales Representatives ..... (See p. 452)

Chemical Engineering (with Chemical & Metallurgical Engineering) is published monthly with an additional issue in Mid-October by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office: 99-129 North Broadway, Albany 1, N. Y.

▶ **Executive, Editorial and Advertising:** 330 West 42nd St., New York 36, N. Y. Donald C. McGraw, President; Paul Montgomery, Executive Vice President; Joseph A. Gerardi, Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising; J. E. Blackburn, Jr., Vice President and Director of Circulation.

▶ **Subscriptions:** Write to Chemical Engineering—Subscription Service, 330 West 42nd St., New York 36, N. Y. Allow one month for change of address. Please show position and company connection on all orders.

Single copies $1 in U. S., Possessions and Canada; $2 in all other countries. U. S. and possessions, $3 per year, $4 for two years, $5 for three years; Canada, $4 per year, $6 for two years, $8 for three years; other Western Hemisphere and the Philippines, $15 per year, $25 for two years, $30 for three years; all others: $20 per year, $30 for two years, $40 for three years.

Entered as second-class matter Sept. 3, 1936 at Post Office at Albany, N. Y., under act of March 3, 1879. Printed in U.S.A.

Copyright 1955 by McGraw-Hill Publishing Co., Inc. All Rights Reserved.

Member A.B.P. Member A.B.C.

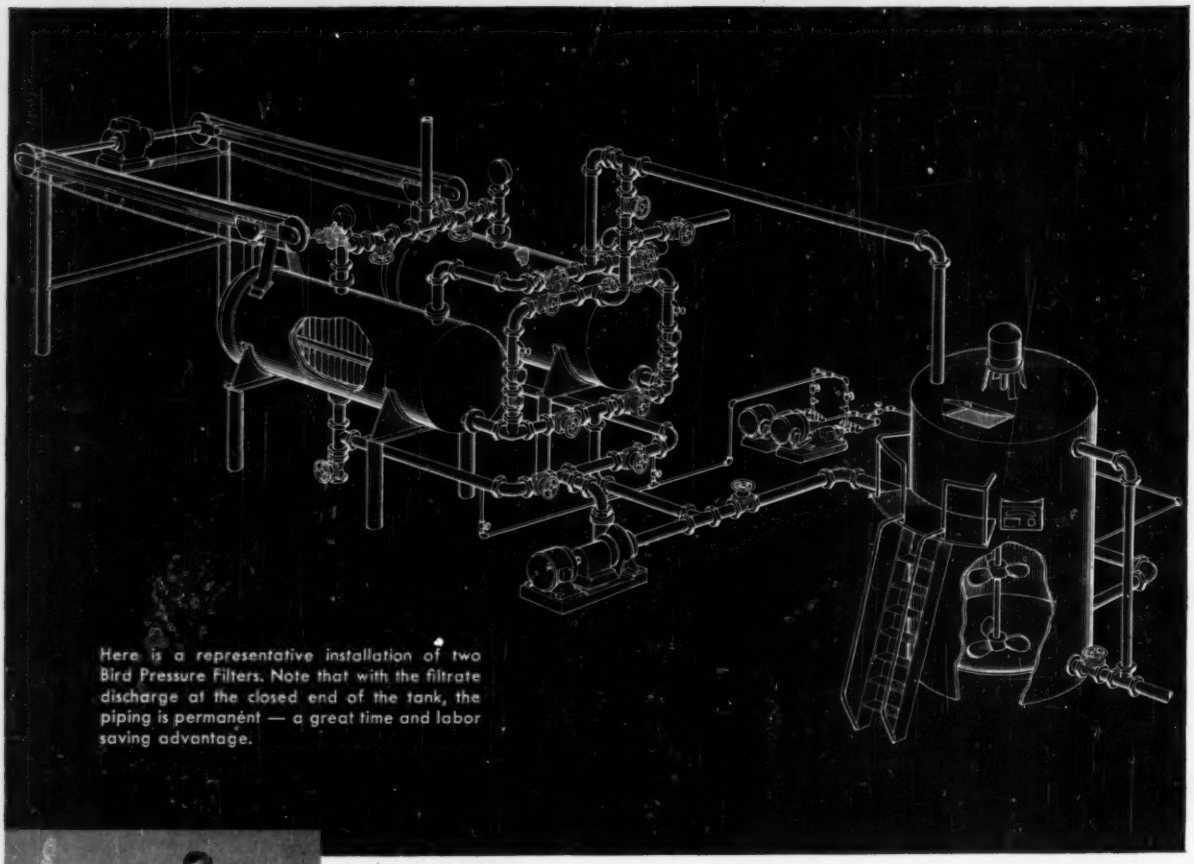
To keep pace with the chemical, petrochemical and chemical process industries, more engineers subscribe to Chemical Engineering than to any other publication. Total net paid circulation of this issue:

39,354

THE PIPING STAYS PUT

When You Put In

BIRD PRESSURE FILTERS



Here is a representative installation of two Bird Pressure Filters. Note that with the filtrate discharge at the closed end of the tank, the piping is permanent — a great time and labor saving advantage.



Pilot-size units are available for testing performance in advance of installation. The findings are backed by unsurpassed experience in Pressure Filter design and application and by one of the world's finest test laboratories devoted exclusively to the solving of filtration and clarification problems.

The BIRD Pressure Filter is equipped with a new and exclusive *self-sealing filtrate manifold.*

This means that the filtrate discharge can be at the fixed end of the tank — not at the movable end. *You don't have to disconnect the piping every time the Filter is opened and cleaned.*

This is but one of the many important advantages of Bird Pressure Filter design and construction. The whole story is contained in a NEW BULLETIN. May we mail you a copy?

BIRD MACHINE COMPANY
SOUTH WALPOLE • MASSACHUSETTS



IF YOU HAVE A CONVEYOR JOB HANDLING ABRASIVE OR CORROSIVE MATERIAL... *HERE'S YOUR IDLER!*

The Joy Limberoller idler installation shown above is in a magnesium foundry, supporting a 30″ belt which carries abrasive material up a 35° slope. *To date, these idlers have been on the job 10 times longer than conventional idlers previously lasted—and they're still going strong!*

ONLY 2 BEARINGS, UP OUT OF THE DIRT ...The Joy Limberoller idler consists of neoprene discs molded on neoprene-covered flexible steel cable. It is suspended from two bearings, on on each end, *out of the dirt zone.* This distinctiv, design, field-proved by thousands of idlers already in service, averts fouled idler rolls—protects the belt from damage—reduces your maintenance to a fraction.

OTHER ADVANTAGES, TOO . . . Joy idlers are self-training—they conform to the load with a cushioned grip which supports the loaded belt without slipping and reduces belt wear. They resist corrosion, abrasion, flame and grease—weigh ⅔ less than steel idlers, and handle bulk or packaged materials equally well. They're easily changed *without stopping the belt,* and compactly stored.

Whatever your belt conveyor job may be, let us help you to make it more efficient and economical. Joy Limberoller Idlers are available for belt widths of 18″, 24″, 30″ and 36″—and you'll find them easier, faster and less costly to install, maintain, knock down and move than any other conveyor idler on the market. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WRITE FOR COMPLETE DETAILS



Ask for free *Bulletin LD-103E.* It gives complete information on the unique Limberoller Idler, and we'll be glad to supplement it with engineering assistance on your particular problem.

Consult a Joy Engineer

W&D 15696

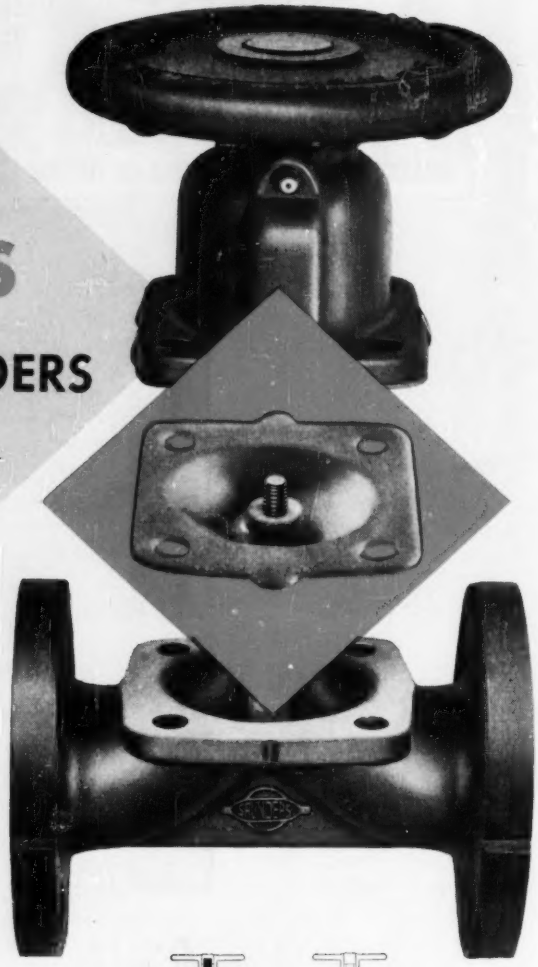
JOY

SINCE 1851—OVER 100 YEARS OF ENGINEERING LEADERSHIP

Unaffected by all chemicals normally found in industry

Teflon Diaphragms

for GRINNELL-SAUNDERS DIAPHRAGM VALVES

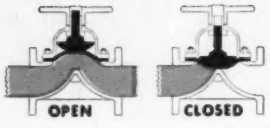


Having valve trouble? Are your chemical services so tough that valves disintegrate? Grinnell-Saunders Diaphragm Valves with TEFLON* diaphragms may solve your problems.

Grinnell TEFLON diaphragms are made by a new and unique process which produces a better product of greater density, toughness and flex life. TEFLON offers a high degree of chemical inertness to all chemicals normally found in industry.

Grinnell-Saunders Diaphragm Valves are available with bodies of iron, bronze, stainless steel, cast steel, aluminum, Monel, Saran, Durimet; and with body linings of glass, lead, soft or hard rubber, neoprene, Saran. Diaphragm life depends on temperature, pressure, and frequency of operation. Your inquiries, which should be accompanied by complete service data, will receive prompt attention.

**Registered Trade-Mark, E. I. du Pont de Nemours & Company, for its tetrafluoroethylene resin.*



- Diaphragm lifts full height for streamlined flow in either direction
- Resilient diaphragm assures positive, leak-tight closure even with grit or scale in the line
- Diaphragm absolutely isolates working parts from fluid . . . sticking, clogging, contamination, corrosion eliminated
- Body, lining, and diaphragm materials to suit service
- Simple maintenance. Diaphragm can be replaced easily without removing valve from line. No packing glands to demand attention. No metal-to-metal seats to become damaged or wire-drawn

GRINNELL

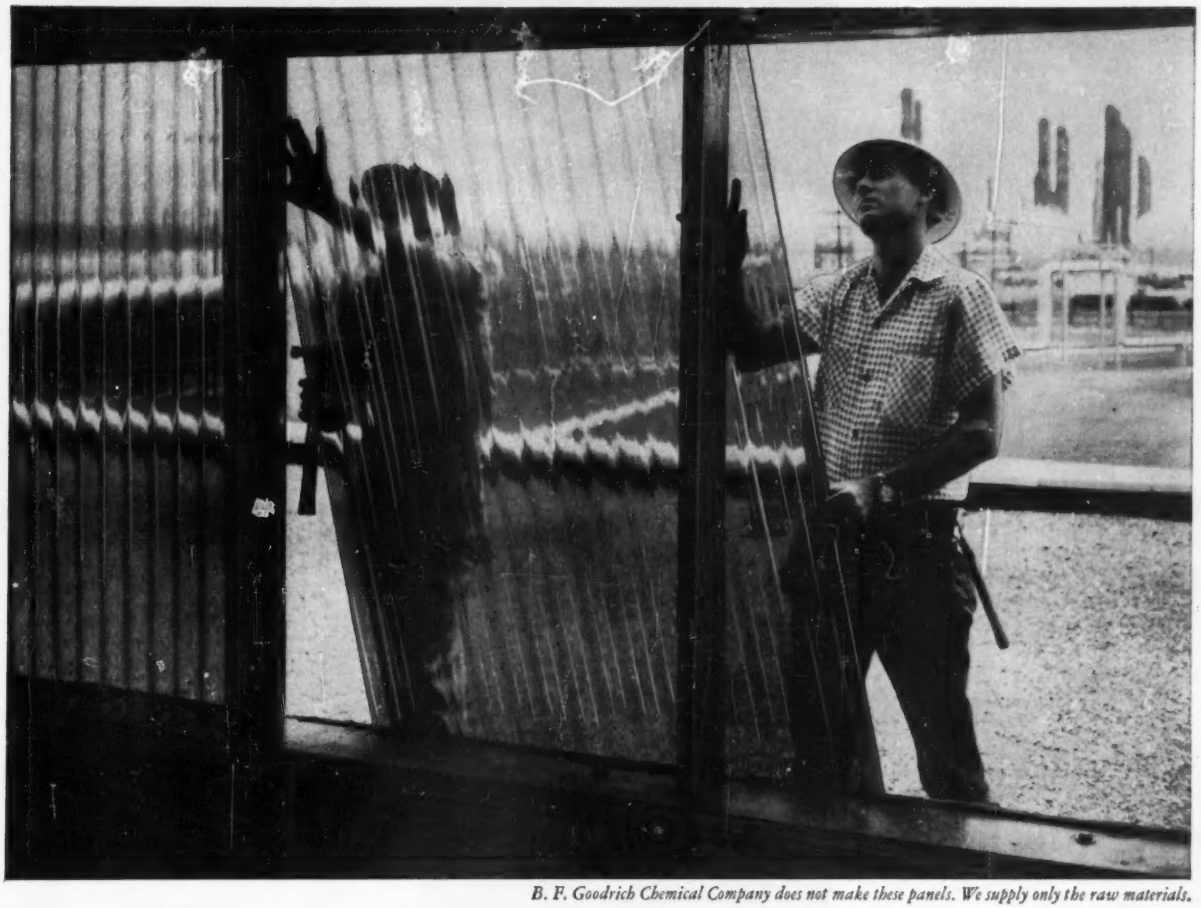
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not make these panels. We supply only the raw materials.

Rigid vinyl windows beat double trouble

WHAT do you do when windows are attacked from two sides? By corrosive fumes and hot air inside, and outside by the weather. A chemical plant in Texas had the problem and found the answer. In went new translucent panels made from Geon rigid vinyl—out went the old windows and a costly maintenance problem!

Installing the green-tinted corrugated panels was easy—they were simply nailed in place. Because they are made from Geon, they resist sunlight, cold, rain, acids, alkalis, oil and grease. They are decorative as well as functional.

Products made from Geon rigid vinyl include corrosion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. You'll find other Geon polyvinyl materials in flexible, colorful upholstery, in high-dielectric insulation, in wear-resistant flooring, in hundreds of other successful products.

Geon's remarkable physical and chemical properties may give your products a decisive competitive edge.

For technical information, please write Dept. BB-7, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors



Seamless fittings with all the plus values...at no extra cost

Your corrosion piping system can be designed better, assembled faster, made light and tight by using *FLOWLINE* fittings, butt-welded to straight-cut pipe. Available from stock through leading distributors. Made in sizes ½" through 12" — Schedules 5S, 10S, 40S, 80S — Stainless Types 304, 304L, 316, 347; Monel, Nickel, Aluminum.

WELDING FITTINGS CORP.

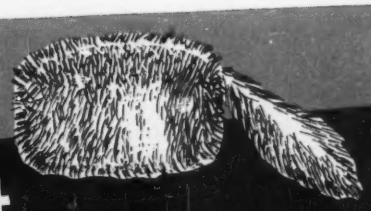
NEW CASTLE, PENNSYLVANIA

World's Largest Manufacturer of Stainless Welding Fittings

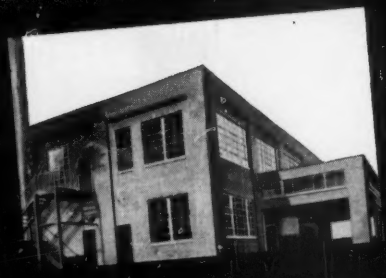
Remember **FLOWLINE®** WELDING FITTINGS

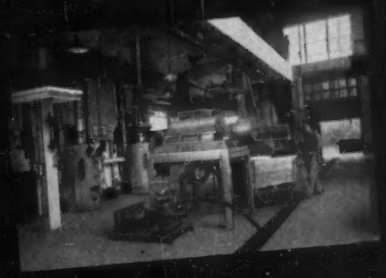
Forget CORROSION PIPING PROBLEMS

As Davy Crockett said:



"Be sure you're right...





BIRD offers you the unsurpassed, pilot scale testing resources of this

RESEARCH and DEVELOPMENT CENTER

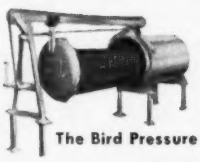
— a completely equipped laboratory devoted exclusively to solids-liquids separation problems.

You are free to use these superb facilities as if they were your own pilot plant.

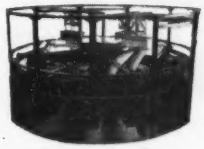
Findings are quick, accurate, confidential.

You get the facts before you commit yourself to any equipment investment.

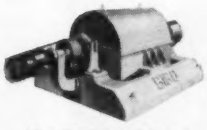
Then, go ahead!"



The Bird Pressure Filter



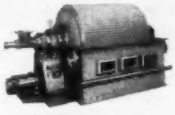
The Bird-Prayon Continuous, Rotary, Horizontal, Pan Type Vacuum Filter



The Bird Solid Bowl Continuous Centrifugal Filter



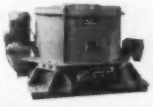
The Bird Screen Centrifugal Filter



The Bird-Young Continuous Rotary Vacuum Filter



The Bird Suspended Centrifugal



The *New* Bird-Humboldt Oscillating Screen Centrifugal Dryer

BIRD offers you the world's most complete range of

SOLIDS-LIQUIDS SEPARATION EQUIPMENT

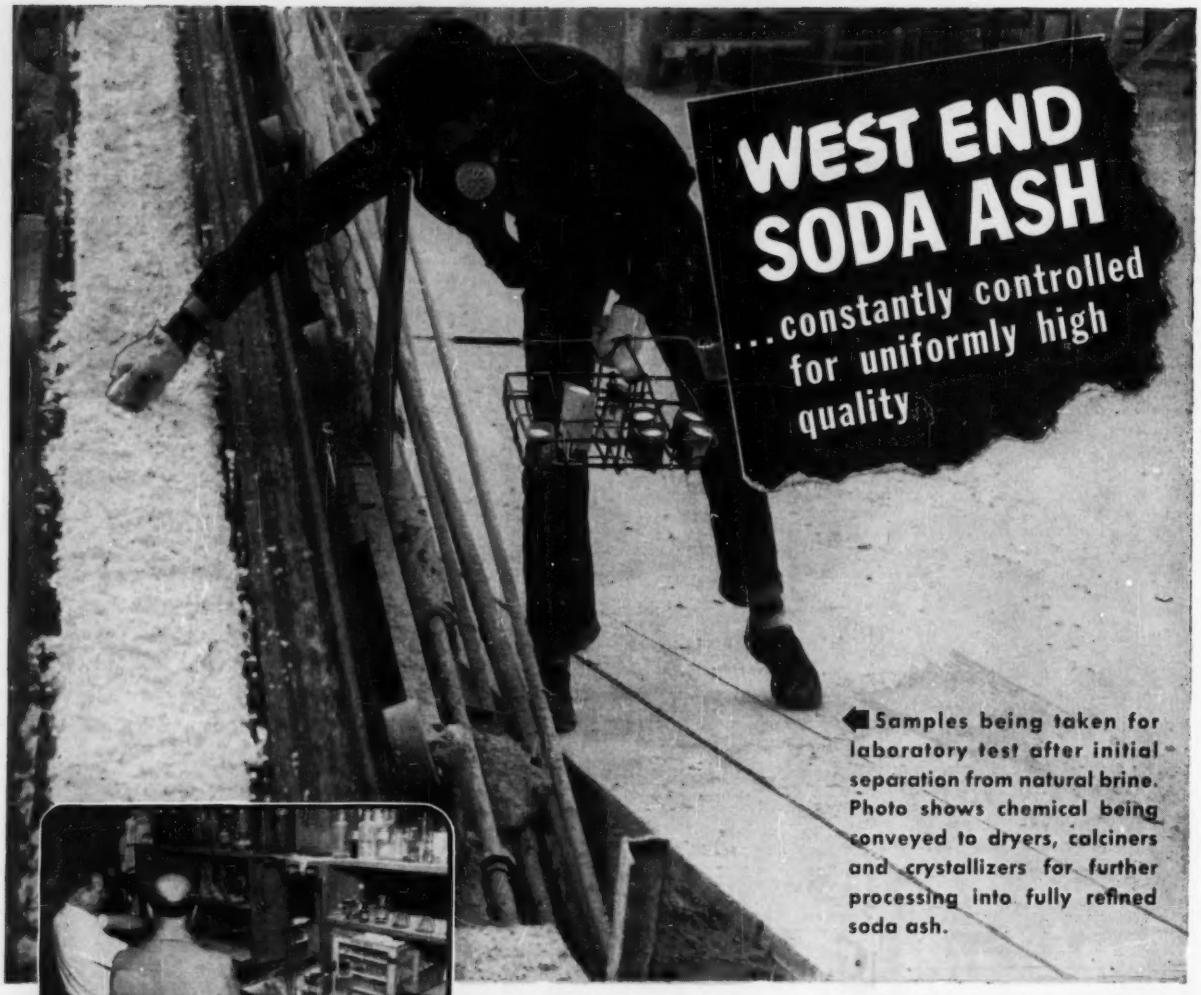
— no monkeying with the flow sheet to allow for filtration limitations or bottlenecks. You can *know you're right, then go ahead* and install the one best filter for the job!

BIRD MACHINE COMPANY

SOUTH WALPOLE, MASSACHUSETTS

WEST END SODA ASH

...constantly controlled for uniformly high quality



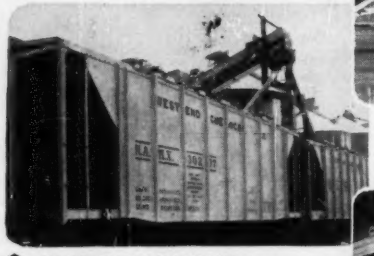
Samples being taken for laboratory test after initial separation from natural brine. Photo shows chemical being conveyed to dryers, calciners and crystallizers for further processing into fully refined soda ash.

Many laboratory tests are made of the product during chemical processing from natural brine to finished soda ash.

West End is a pure white, free-flowing and rapidly soluble soda ash that produces a far cleaner, more uniform product. In continuous production, it is available at all times in fully adequate quantities for the normal and emergency needs of western customers. Fast, economical transport by rail or truck to any point in the West.



PERSONAL SERVICE — Customers anywhere in the West are only a few hours away by company plane.



IMMEDIATE SHIPMENT to customers throughout the West in company's own leased hopper cars . . . ready at all times.



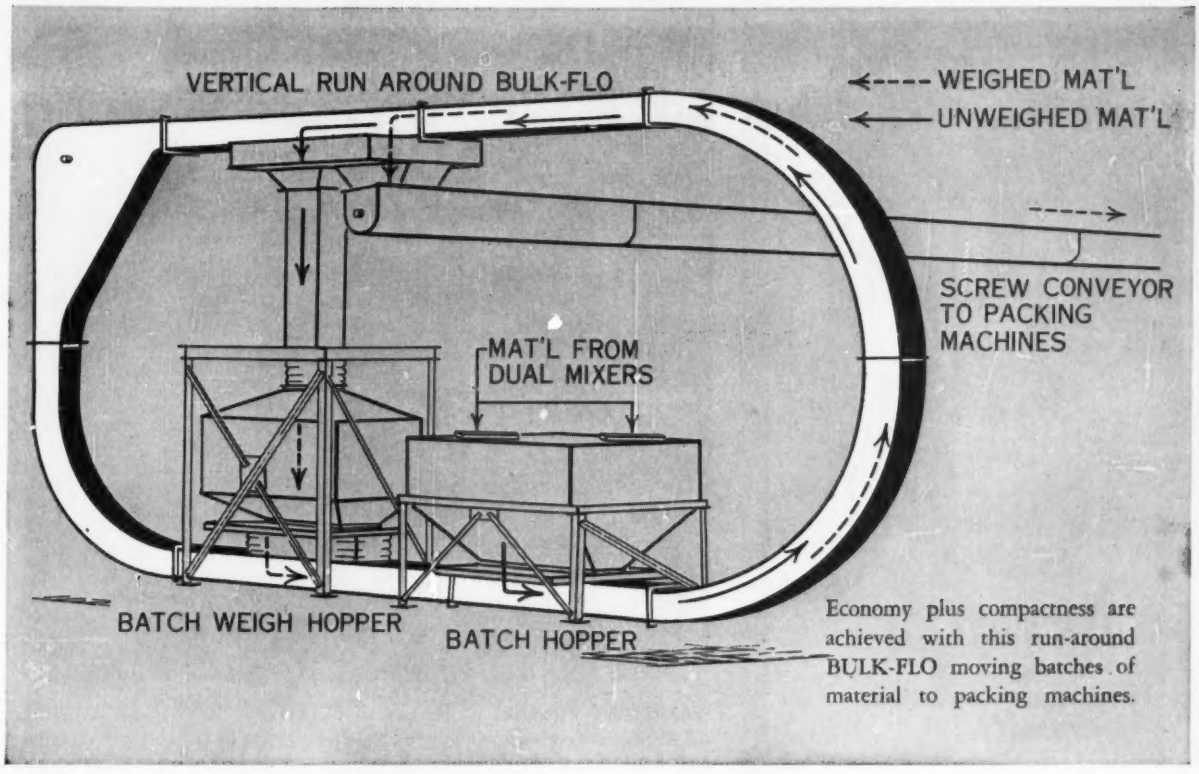
30 MINUTE IN-AND-OUT LOADING for bulk trucks at any hour of day or night through "serve yourself" delivery.

WEST END CHEMICAL COMPANY

Write for samples, prices and technical data.

West End Chemical Co.

Executive offices: 608 Latham Square Building, Oakland 12, California • Plant: Westend, California

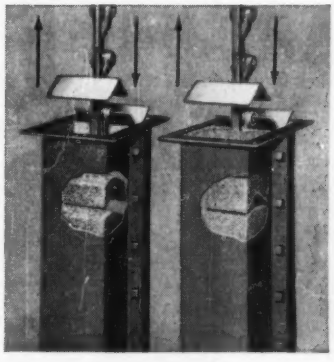


Economy plus compactness are achieved with this run-around BULK-FLO moving batches of material to packing machines.

How a single BULK-FLO unit combines feeding, conveying, elevating

Compact...reduces costs...operates fully or partially loaded

HERE'S a single, fully-enclosed assembly that moves materials vertically, horizontally, on an incline or any combination of these. Often replacing several handling units . . . in less space . . . at lower cost—BULK-FLO has solid flights (see right) that provide individual "compartments" to protect friable materials. You get positive operation whether BULK-FLO is fully or partially loaded. Ask your nearby Link-Belt office for facts or mail the handy coupon for copy of Book 2475.



Fully or partially loaded — Link-Belt BULK-FLO assures positive, gentle movement of materials. Self-clearing through intermediate runs, it prevents contamination.



LINK-BELT

13,742

BULK-FLO FEEDERS · CONVEYORS · ELEVATORS

LINK-BELT COMPANY
307 N. Michigan Ave.
Chicago 1, Ill.
(Or your nearest Link-Belt office)

Please send me immediately a copy of your 28-page BULK-FLO Book 2475.

Name .....
Firm .....
Address .....
City ..... Zone .... State .....

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Life on the Chemical Newsfront



WAXES AND POLISHES which contain Cyanamid's CATIONIC SP Antistatic Agent have proved effective in reducing dust and lint pickup. Desired gloss on polished surfaces usually is brought out by rubbing or buffing. Static charges generated by such treatment strongly attract lint and dust. However, CATIONIC SP in amounts of 1% to 5% in wax pastes or emulsions reduces such pickup markedly. (No. 1)

NEW LINE OF ACCOSPERSE® PIGMENT DISPERSIONS gives a variety of deep shades and medium to light tints for popular rubber latex interior architectural finishes. ACCOSPERSE pigment dispersions are standardized in color, strength, consistency and bulking value. They contain alkali-resistant pigments in a high degree of dispersion. They eliminate grinding and simplify paint formulation because they provide:

1) high color concentration
2) wide compatibility
3) easy handling and mixing
4) good stability
5) resistance to migration and flushing
6) freedom from efflorescing salts. (No. 2)





ROUND-THE-WORLD LUGGAGE comes back good as new. Made of glass fiber and Cyanamid's LAMINAC® Polyester Resin, these cases withstand the rough handling that usually breaks, dents or scars ordinary luggage. They are available in a range of attractive colors which are molded in so the color can't chip or peel. And their handsome finish, with glass fibers contributing an interesting random pattern, will not stain or absorb dirt or moisture. (No. 3)



FLEXIBLE VINYL WALL TILE stays supple and durable for years, thanks to phthalate plasticizers made with AERO® Phthalic Anhydride. Available in high purity, and in either flake or molten form, AERO Phthalic Anhydride imparts no unwanted color characteristics to plasticizers for vinyl compounds. Low volatility of these plasticizers assures retention of flexibility. Yet, for all its qualities, AERO Phthalic Anhydride is low in cost. (No. 4)

News Briefs

AEROCARB® S AND R CARBURIZING COMPOUNDS offer two cost-reducing factors: high penetration rates for faster case hardening, and wide temperature range in the bath for greater versatility. Simple variation in R to S ratio gives close chemical control. Bath gives light or deep case in minimum time, while finished parts are cleaned easily, are scale free, and unusually bright. (No. 5)

AMMONIA SYNTHESIS proceeds at peak efficiency with AERO® Specialty Catalysts. High activity and long-term stability of these catalysts are time-proved properties. Specific AERO Catalysts are available for each commercial process: hydrogen production by methane-steam reaction or water-gas shift reaction, or direct ammonia synthesis from nitrogen and hydrogen. A new bulletin on AERO Specialty Catalysts will be sent on request. (No. 6)

MEGASUL® NITROPHENIDE, safest, most effective drug for preventing coccidiosis in chickens, now is offered to feed manufacturers in a free-flowing, non-bridging, dust-free form. This assures even distribution of nitrophenide throughout every bag of feed. In addition to preventing outbreaks of coccidiosis, continuous feeding of MEGASUL to birds results in faster, more uniform growth, more efficient feed utilization, and improved well-being. (No. 7)

CYPEL® PAPER RESIN EMULSION, now available, produces excellent grease-resistant coatings with heat-sealing properties on paper and paperboard. CYPEL blends with starch, casein, soya proteins, and synthetic water-dispersible polymers to give toughness and non-blocking qualities to grease-proof paper coatings. (No. 8)

®Trade-mark

AMERICAN Cyanamid COMPANY

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

C.E.

SEND more information on the following items mentioned in the July, 1955 issue of LIFE on the Chemical Newsfront:

No. 1, 2, 3, 4, 5, 6, 7, 8.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

Red hot problem

ANOTHER UNUSUAL FLOW MEASUREMENT PROBLEM SOLVED BY TAYLOR INGENUITY !

The picture shows an 8" all-welded stainless steel calibrated orifice section 24 ft. long, to be used as a primary standard. It's red hot because it measures the flow of molten sodium which is used as a heat transfer medium in an atomic energy project.

What's unusual about this? First, construction of such a large section is uncommon indeed, and immediate delivery was imperative lest it hold up an important project. Second, the calculation, design and fabrication of the primary element required highly specialized knowledge and skill. Third, certification of calibration by an independent laboratory revealed accuracy well within the specified limits.

What's *not* unusual about it? The customer brought his urgent and exacting problem to Taylor Instrument Companies for solution.

A repeat order soon after delivery is a tribute to the ingenious application engineers on the Taylor payroll. Their speed and resourcefulness in solving this out-of-the-ordinary flow measurement problem typifies the desire of everyone at Taylor to handle unusual jobs unusually well.

Probably your instrumentation problem has nothing to do with molten sodium measurement, but it's equally probable we'd have a good answer. Why not call your Taylor Field Engineer today? Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



8" all-welded stainless steel calibrated orifice section for measuring flow of molten sodium.

Taylor Instruments

MEAN ACCURACY FIRST

INDICATING, RECORDING, CONTROLLING

TEMPERATURE, PRESSURE, FLOW, LIQUID LEVEL,

SPEED, DENSITY, LOAD AND HUMIDITY

FAMOUS LIGHTHOUSES OF AMERICA

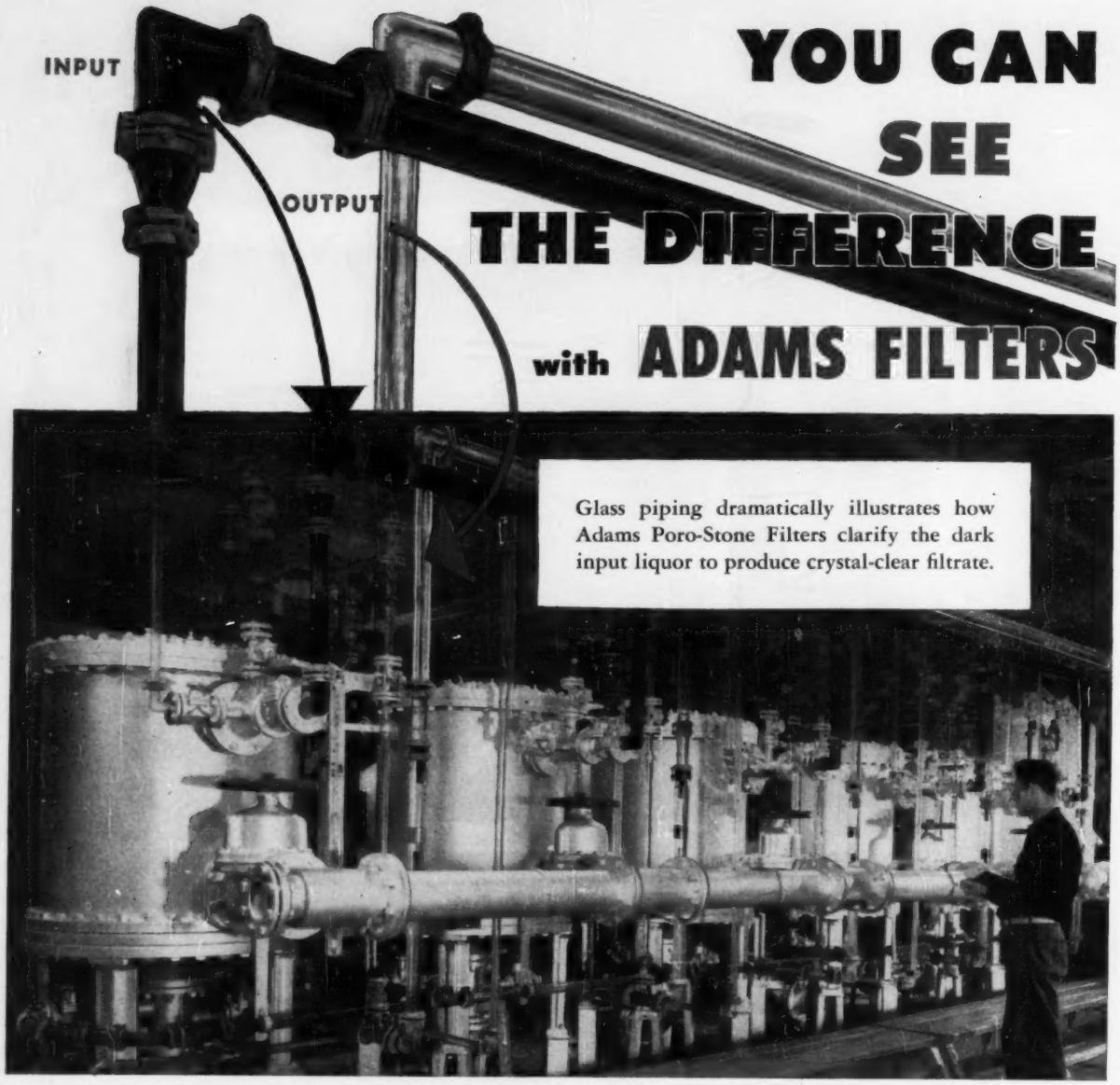


SANDY HOOK LIGHTHOUSE, built in 1764 by the Colony of New York, is the oldest original light tower in use in the United States. A massive structure, octagonal in form with walls of stone seven feet thick at the base, it stands today as it was built except for an added inner lining of brick. This famous lighthouse is located on a narrow peninsula on the New Jersey coast sixteen miles due south of New York City and still helps to guide ships into New York's lower bay.

Sure guidance for users of electrochemicals is the long-recognized quality of Niagara Alkali products. A pioneer in this field, Niagara has helped manufacturers improve their products and the efficiency of their processes through the use of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.



YOU CAN SEE THE DIFFERENCE with ADAMS FILTERS

Glass piping dramatically illustrates how Adams Poro-Stone Filters clarify the dark input liquor to produce crystal-clear filtrate.

Dramatic Results with ADAMS Poro-Stone Filters at BECCO

Efficient filtration is a critical process requirement in the electrolytic preparation of hydrogen peroxide. Thus at the Buffalo plant of the BECCO Chemical Division, Food Machinery and Chemical Corporation, the most effective filtration equipment was vitally necessary.

Finely divided iron compounds are precipitated during purification of the cathode liquor. This precipitate must be completely removed before recycling the filtrate to the cells to insure high process efficiency and ultimate product purity.

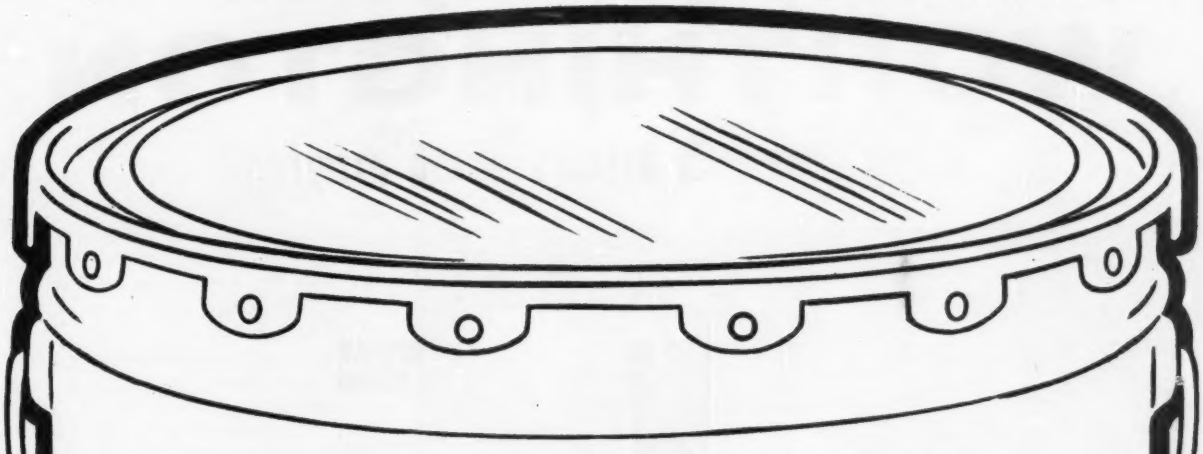
Adams Filters with inert Poro-Stone media were chosen for this critical filtration process in the initial installation. Rubber lined construction and glass piping were also specified to prevent any possibility of product contamination.

Increasing demand for BECCO high-purity peroxide made additional production facilities necessary in 1949 and again in 1951, plus another installation in their new west coast plant. On the basis of their excellent performance, Adams Poro-Stone Filters were specified in each case.

Do you have any filtration problems in your process? Our Engineering Department will be glad to be of help. For general information on Adams Chemical Filters write for a free copy of Bulletin 431.

R. P. ADAMS CO., INC.
207 E. PARK DRIVE BUFFALO 17, N. Y.

Make friends with Continental's steel containers

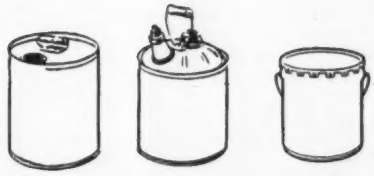


Rust-proof re-usable
FLARING PAILS

Inside and out, Continental steel flaring pails are built to give your dry, powdered and viscous products the fullest measure of protection. Sales appeal, however, is just as much a part of these pails as sturdy construction. Brightly lithographed by Continental craftsmen, each container becomes part of a handsome package "family." And long after the original contents are gone, your name on these handy re-usable pails will help you sell not just one, but *all* the products in your line. Let us show you how Continental flaring pails can work for you. Call anytime.



Why not order "Tripletite" paint cans, "F" style and conventional cans when you order steel containers? We'll make up a "mixed" freight car to cut your costs on shipping, warehouse space and inventory.



A COMPLETE LINE—FIRST IN QUALITY

Durable, handsome Continental flaring pails available in 10 lb., 3½, 4, 5, and 6½ U. S. gallon sizes. 29-, 28-, or 26-gauge steel throughout. Bottom compound lined with 5 thickness strength for extra protection. Cover has deep gasket groove and full skirt to provide a sure seal. Beads near top, bottom or both for greater rigidity and strength. Covers specially designed to prevent sticking or jamming in storage. All pails nest snugly for economical shipping.

Continental makes a full line of closed head drums, lug cover pails and utility containers. Whatever your needs; Continental will supply the sizes and styles that fit your products best.

CONTINENTAL CAN COMPANY

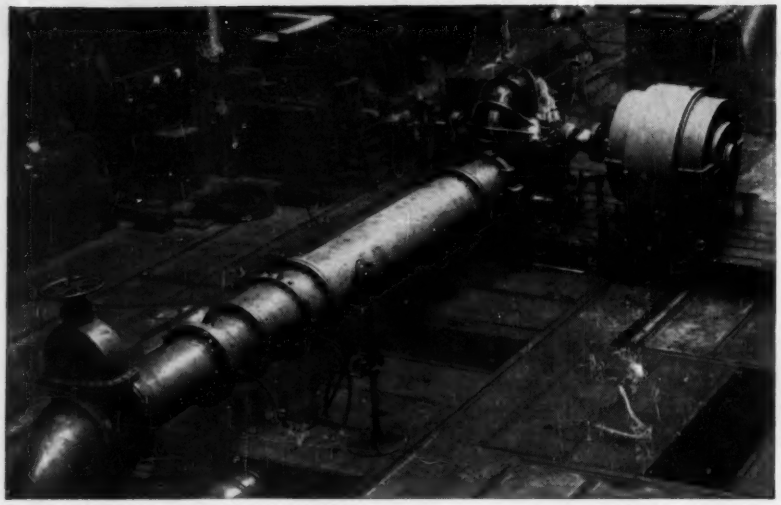
Eastern Division: 100 E. 42nd St., New York 17
Central Division: 135 So. La Salle St., Chicago 3
Pacific Division: Russ Building, San Francisco 4

Our Fiftieth Year of Tailor-Made Packaging

TAILOR-MADE PACKAGE SERVICE

Keep your eye on WORTHINGTON

Pump research primes pump progress





TEST STAND CAPACITY UP TO 100,000 GPM is provided at Worthington's Harrison plant *(above)*. Built over a man-made half-acre lake, the test stand is used as a production tool to check pumps from fractional horsepower up. This flexibility comes in handy—in one line alone Worthington can put together 60,000 different standard pumps out of 650 parts in six standardized sets of liquid ends.

DIRECTING PUMP TEST OPERATIONS from central control room *(left)* where special measuring instruments speed collection of performance data. Worthington pump specialists can afford to be objective in considering your pump application problem. They select from the most complete line of pumps offered by any manufacturer.

We have a lot of experience at Worthington—more than 114 years of it—and we're picking up more all the time.

But technology advances every day. Each step forward brings with it new and unsolved pumping problems. That's why Worthington's research and development program is continuous. That's also why we like to work with you during planning to get the jump on problems before they reach the costly stage.

Experts for every problem

For your day-to-day pumping problems, our sales engineers are thoroughly trained in pump applications in every field, and can usually supply the right answer fast. Naturally, for the really tough ones, our staff engineers back them up with all the equipment and facilities of our shops and laboratory. In addition, factory-trained troubleshooters are available to cope with any problem that may arise in the field.

From cat-cracker to atom-cracker

Our specialists, covering all major industries, work as a team. Together, they bring to bear on any problem a vast store of experience. They've successfully solved pumping problems and helped pioneer new developments in public works, atomic energy applications, the oil industry, and the chemical industry —to name a few.

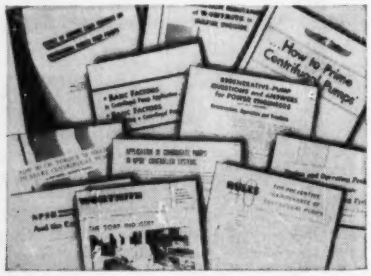
So keep your eye on Worthington; we probably have a money-saving answer to your pumping problems. C.S.1



WORLD'S FIRST ATOMIC-POWERED SUBMARINE, *NAUTILUS*, undergoing sea trials. In atomic development since 1941, Worthington recently built special engine room equipment for both atomic submarines, *Nautilus* and *Sea Wolf*. Worthington continues to figure prominently in supplying this new field of atomic energy, keeping pace with its new and rapidly changing requirements.

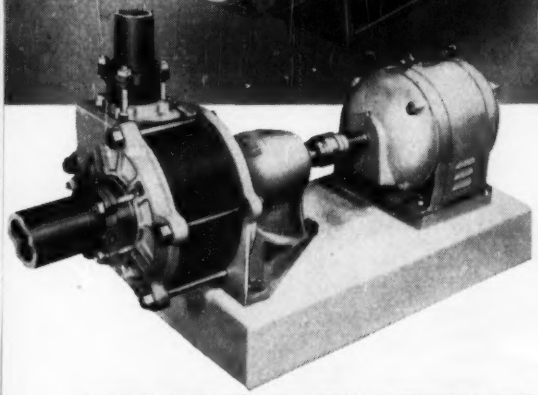


EUTECTIC CASTING, used in making standard Worthington pumps, frees engineer from casting restrictions. Formerly, design of impeller and diffuser blades had to allow hand withdrawal from fragile sand core. Eutectic casting uses a low-melting-point alloy to form blades, melting this alloy out during baking. This permits design flexibility for maximum hydraulic performance.

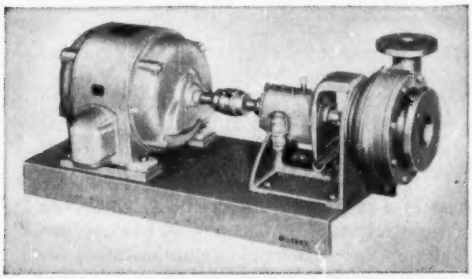


VITALITY OF WORTHINGTON RESEARCH PROGRAM is shown by the more than 300 articles in the technical press during the past five years by Worthington people. This flood of informative technical literature not only reflects our ability to keep pace with the changing hydraulic requirements for modern pumps, but also highlights the important contributions by Worthington to the knowledge of pumps.





FAMOUS KARBATE* NON-METALLIC CHEMICAL PUMP, made of impervious graphite by National Carbon Company. Now you'll be able to buy this pump from Worthington. Karbate pumps include motor-mounted (close-coupled) and frame-mounted units with capacities ranging from 5 to 1500 gpm at heads to 110 feet at conventional motor speeds.



WORTHITE TYPE CNG CENTRIFUGAL CHEMICAL PUMP. Super-stainless Worthite provides best all-round metallic corrosion resistance in a standard pump. Manufactured in 27 standard sizes, it assures you of complete hydraulic coverage up to heads of 235 feet and capacities of 2500 gallons per minute. Worthite type CNG pumps are available with standard stuffing boxes, with Teflon seal cage arranged for independent cooling liquid, or with external mechanical seal.

Now Worthington offers you the widest standard corrosion-resistant pump line

as Karbate* impervious graphite supplements Worthite

Worthington Corporation is now marketing Karbate brand centrifugal pumps, manufactured by National Carbon Company, a Division of Union Carbide and Carbon Corporation, in addition to our Worthite centrifugal chemical pumps.

In Karbate pumps, parts in contact with the liquid pumped are made of impervious graphite, making the pumps applicable for many corrosive services where conventional metals or alloys are unsuitable.

Worthite pumps already form the broadest line of metallic centrifugal pumps in the industry. This coverage is now completed by the addition of the non-metallic Karbate Brand Impervious Graphite Pumps. You'll find Worthite and Karbate pumps your best bet for virtually 100 percent of corrosive applications.

Worthite is a high-nickel, high-chromium, molybdenum alloy steel, with 0.07 percent maximum carbon content. It is stainless and its stabilizing elements tend to prevent intergranular corrosion.

Write today for copies of bulletins W-350-B14A and W-350-B18 describing in detail Worthite and Karbate centrifugal chemical pumps. Worthington Corporation, Harrison, New Jersey. C-5.1A

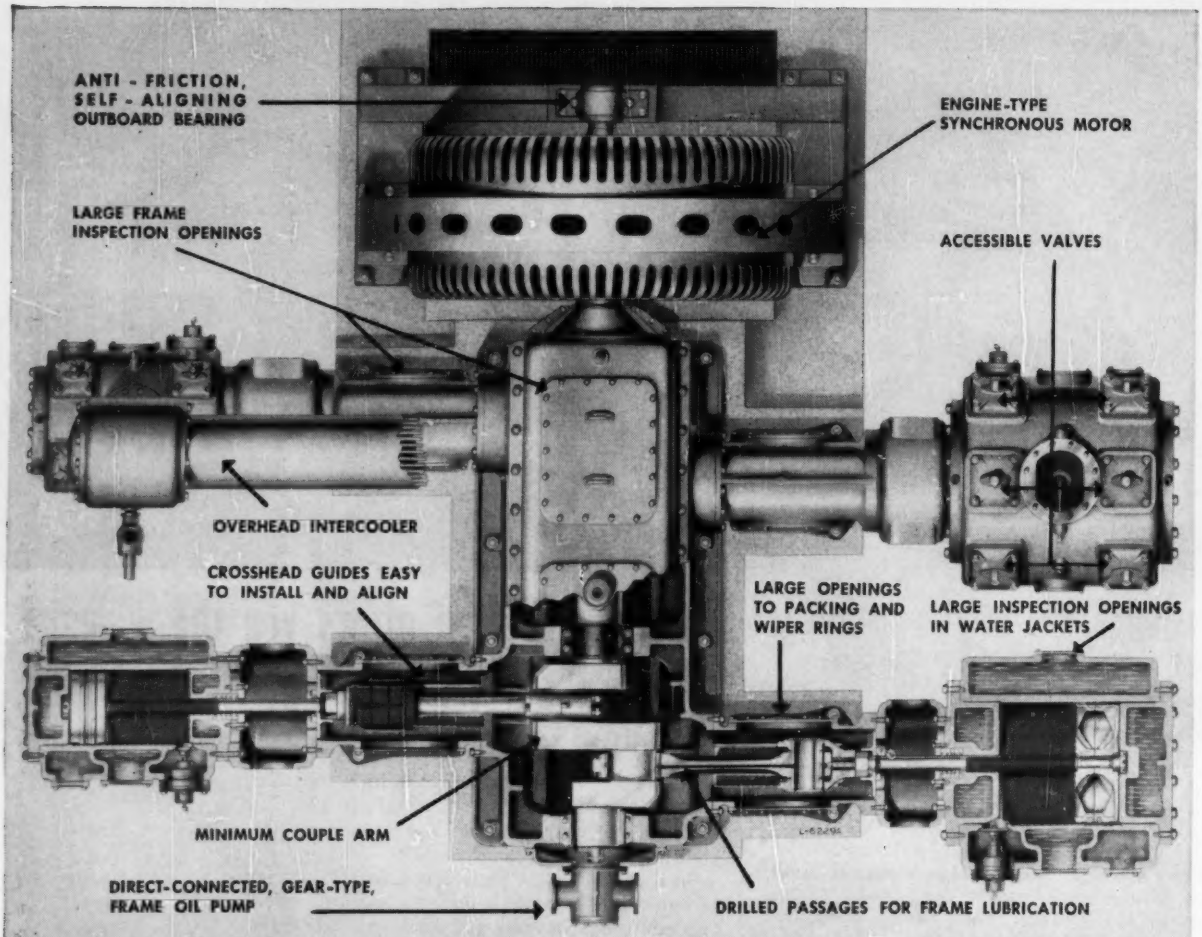
Reg. Trademark of Union Carbide and Carbon Corporation.

WORTHINGTON

THE WORLD'S BROADEST LINE
ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM
POWER • VERTICAL TURBINE

Worthington Balanced Gives LOWEST OPERATING



CUTAWAY OF FOUR CYLINDER BALANCED OPPOSED COMPRESSOR. Just one of the many multi-service cylinder arrangements available. Option of drivers gives full freedom in choice of power or fuel for maximum economy and convenience. Available drivers include: direct-connected engine-type synchronous motor *(shown);* steam turbine through reduction gear; special induction motor; or direct-coupled internal combustion engine. Red areas show lubrication coverage.

"Easier to inspect and maintain than any similar compressor." That's what engineers say about the Worthington Balanced Opposed Compressor.

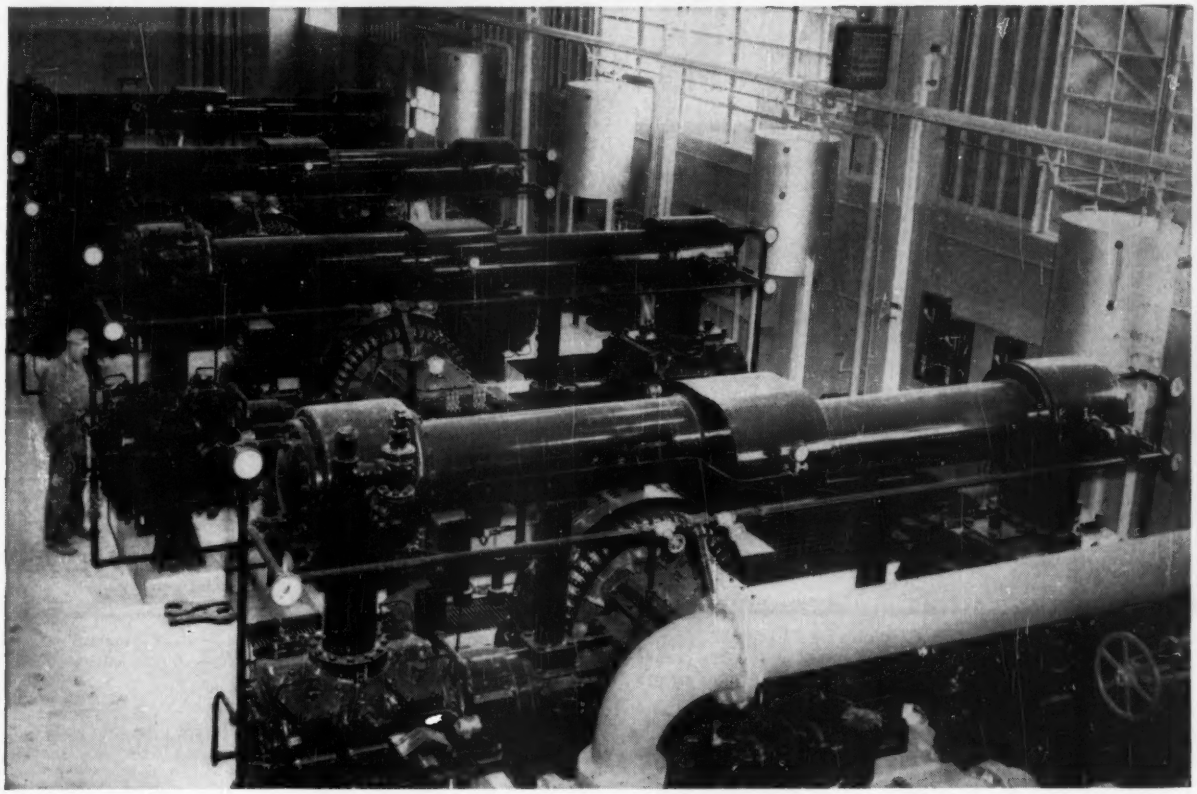
LARGE ACCESS OPENINGS are provided for inspection and maintenance of piston rod packing, oil wiper rings, water jacket, main bearings, crossheads, and crosshead guides. All valves are accessible and easily replaced. This easy accessibility of working parts facilitates *preventive* maintenance, reduces downtime for *corrective* maintenance.

REDUCED INSTALLATION COSTS because foundations can be smaller. Inertia forces developed in one cylinder are bucked and largely cancelled out by similar and opposite forces developed in the opposing cylinder. Only a relatively small turning force, or couple is transmitted to the foundation. As a result, foundations are smaller for the balanced opposed than for equally rated compressors of other designs.

MAXIMUM STRENGTH, MAXIMUM STABILITY, result from the rugged one-piece-cast main frame and most stable construction of any similar compressor. Main bearing supports are integral with frame and reinforced with heavy steel tie bars over each bearing. Keyways in frame seat each tie bar and lock it in place, permanently preserving alignment.

AVAILABLE SIZES AND TYPES range from 300 to 10,000-hp with pressures from vacuum to 35,000 psig. A few applications include (figures indicate orders of magnitude only): *dry vacuum pumps* operating at very low pressures, *standard shop air compressors* (125 psig), *refrigeration gas compressors* (250 psig), and *multi-stage gas compressors* for use in service such as ammonia synthesis, methanol and hydrogenation plants (3500 to 35,000 psig). For more information, write for Bulletin L-679-B1 on company letterhead. Worthington Corporation, Section K.5.2, Harrison, New Jersey.

Opposed Compressor Design and MAINTENANCE COSTS





COMPRESSED AIR for Ford plant in Mahwah, New Jersey, is supplied by this array of four 450-hp, 100 psig Worthington Balanced Opposed Compressors.

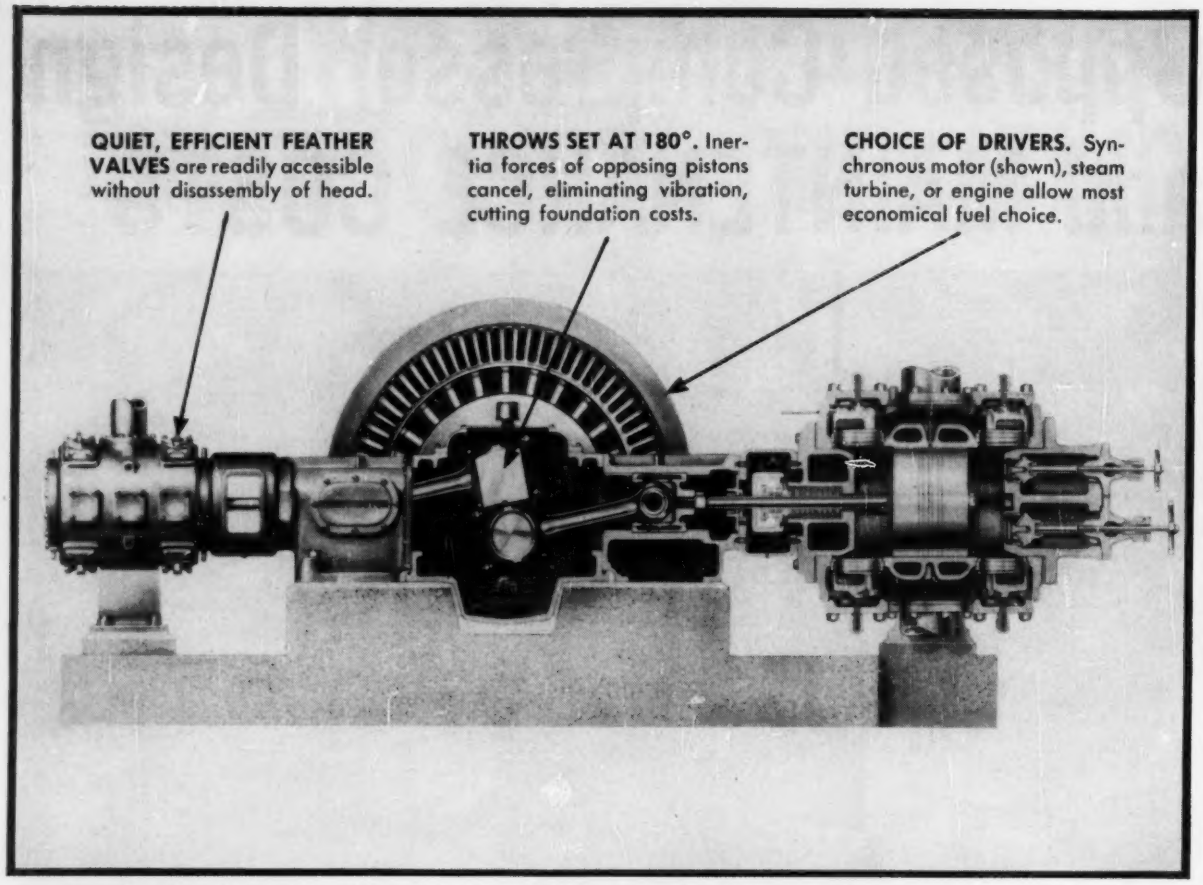
HIGH-SPEED, LOW INERTIA Worthington Feather® Valve contributes to quiet operation and easy maintenance of Worthington Balanced Opposed Compressor. Thin, flexible strips of stainless ribbon steel form active elements. Curved guards hold strips in position over rectangular openings. Strips lift and flex uniformly against guards. Absence of impact results in quiet operation, longest valve life and low maintenance costs.

WORTHINGTON

K-5.2

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors



CUTAWAY VIEW of Worthington's new balanced-opposed compressor shows double-throw crankshaft with cranks set at 180 degrees. Reciprocating weights of pistons always travel in opposite directions, cancelling out all inertia forces. Result: fewer vibration problems; consequently, simpler foundation.

New balanced-opposed compressor handles multi-services all at once

When you have process requirements existing at different low-temperature levels, you don't need a battery of compressors. All you need is one Worthington balanced-opposed unit — with only one driver.

The new balanced-opposed compressor is specifically designed to handle single or cascade refrigeration duties. What's more, you can combine on the same frame refrigeration loads with gas compression, similar to that encountered in chlorine condensing and carbon dioxide liquefaction systems. Result: a big saving in installation and operating costs.

Here are more cost-cutting features:

BALANCED-OPPOSED PRINCIPLE (which virtually eliminates transmission of unbalanced shaking forces to foundation) plus simple frame design permit use of smaller, less expensive foundation.

FEATHER* VALVE OPERATION. Worthington's exclusive Feather Valve provides unusually high compression efficiency — bringing power costs 'way down.

MINIMUM MAINTENANCE COSTS — made possible by quick, easy accessibility to all compressor cylinders and running gear.

WIDE CHOICE OF DRIVERS — synchronous motor, steam turbine, internal combustion engine — whatever drive is easiest, cheapest for you to use.

You can get the Worthington balanced-opposed compressor in sizes from 300 HP all the way up to 10,000 HP. Write for details today to Worthington Corporation, Air Conditioning and Refrigeration Div., Section A.5.60-OG, Harrison, N.J. A.5.60-OG

*Reg. U.S. Pat. Off.

WORTHINGTON

CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

2 COMPLETE LINES for Faster, Safer, More Convenient Liquids Handling . . .



SPRING BALANCED • COUNTER BALANCED

OPW LOADING ASSEMBLIES



Oil and chemical companies alert to reducing tank car and truck loading and unloading time without jeopardizing safety standards and contaminating product are converting daily to the trouble-free operation of OPW LOADING ASSEMBLIES.

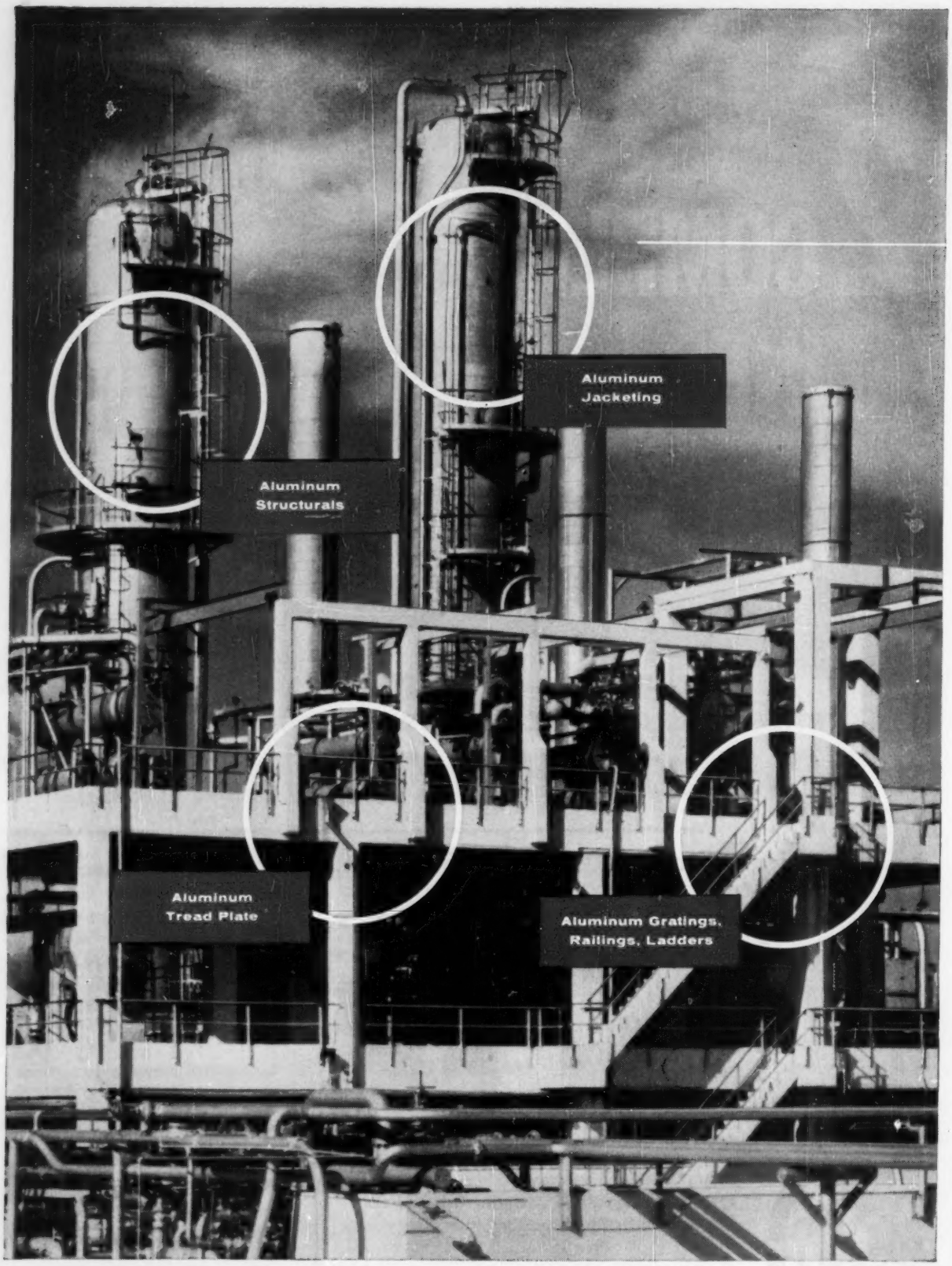
Behind this industry acceptance are several determining factors:

- **COMPACTNESS**
- **CONVENIENCE**
- **FAST DELIVERY**
- **SMOOTH OPERATION**
- **LONG SERVICE LIFE**
- **MINIMUM PRESSURE DROP**

CATALOG F-7 provides sizes, engineering data and specifications on all OPW Spring-Balanced and Counter-Balanced Loading Assemblies. Free on request.

OPW CORPORATION
FOR HANDLING HAZARDOUS LIQUIDS
OPW
VALVES • FITTINGS • ASSEMBLIES
CINCINNATI 25, OHIO

OPW CORPORATION 2735 Colerain Ave., Cincinnati 25, Ohio


Aluminum
Jacketing
Aluminum
Structurals
Aluminum
Tread Plate
Aluminum Gratings,
Railings, Ladders

REYNOLDS

There's Just ONE Price Tag on ALUMINUM

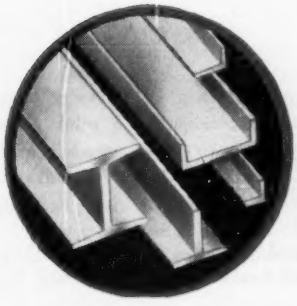


- **NO PAINTING**
- **NO RUSTING**
- **NO REPLACEMENT DUE TO CORROSION**

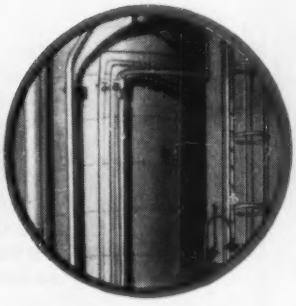
You *can* eliminate continuing expenditures for maintenance on steel plant equipment. Aluminum is unaffected by most plant atmospheres which means painting and replacement due to corrosion disappear from the maintenance budget. Since the cost of a single painting usually will make up the difference in first cost of aluminum compared to steel, savings continue for the life of the plant. And aluminum retains its original good looks.

Additional advantageous aluminum qualities are non-sparking, light weight and natural insulation. Your new construction will proceed faster due to the ease of fabrication of aluminum.

For details on how *much* Reynolds Aluminum can save your company, call the Reynolds office listed under "Aluminum" in your classified telephone directory. Or write to *Reynolds Metals Company, P.O. Box 1800-CJ, Louisville 1, Kentucky.*



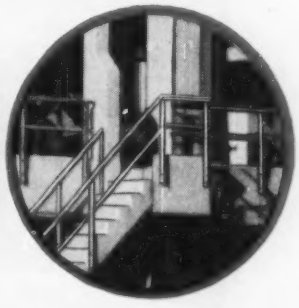
Aluminum Structurals. With strengths equal to structural steel, aluminum is ideal for framework and supports. Maintenance free, one-third as heavy as steel.



Aluminum Jacketing. Provides maintenance-free beauty plus the benefits obtained from natural insulating qualities. Application is fast, easy.



New! Reynolds Aluminum Tread Plate. Resists corrosion. Long wearing diamond treads provide safer footing. Will not spark.

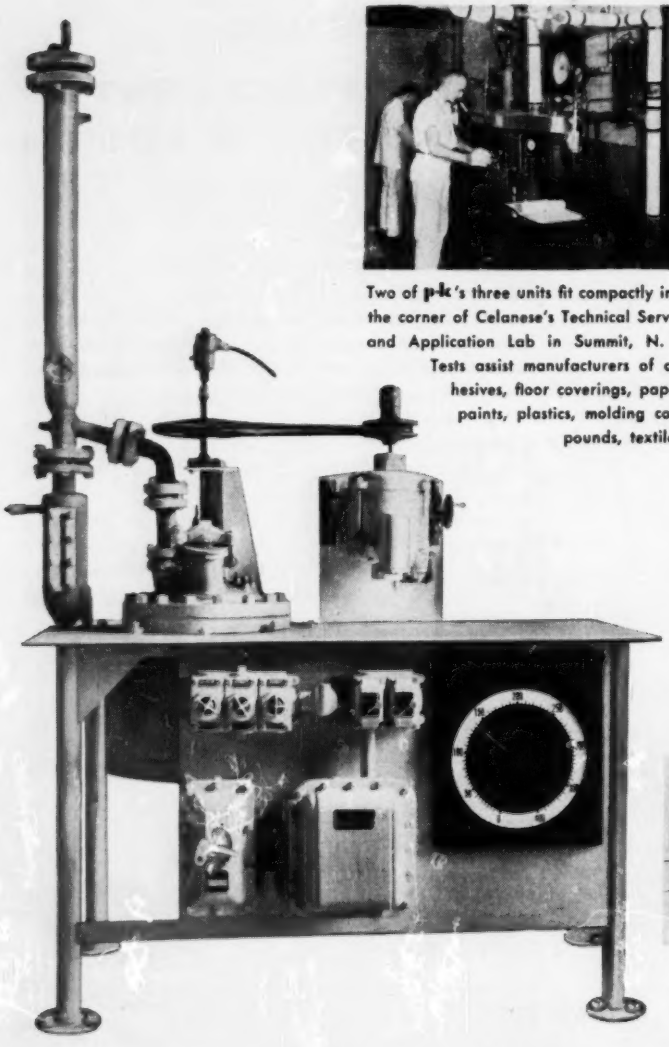


Aluminum Accessories. In gratings, railings, ladders and walkways, aluminum provides strength with light weight and long life.

ALUMINUM

Packaged Pilot Plants

Flexible . . . compact . . . accurate . . . these 'packaged' units are performing hundreds of experiments to help Celanese assist its customers in developing better products



Two of p-k's three units fit compactly into the corner of Celanese's Technical Service and Application Lab in Summit, N. J. Tests assist manufacturers of adhesives, floor coverings, paper, paints, plastics, molding compounds, textiles.

The apparatus at left below is a packaged **p-k** pilot plant, designed for resin experimentation, in five gallon capacity and standardized design.

Three are at work at Celanese Corporation of America's big Research Center: one for vinyl acetate monomers and co-ploymers; one for urea, melamine, and phenol-formaldehyde resins; and one for pentaerythritol alkyd resins. All work full time for Celanese customers.

Each is flexible enough to handle a multiplicity of small operating tests; accurate enough to permit projection to full scale plant operation; adaptable to the most specialized research needs; and low in price. Specifications for the unit at left are typical:

REACTOR: 5 gallon working capacity • 150 PSIG design pressure • Internal cooling cylinder • Electric heater capacity of 6000 watts • Thermostatic controls • Variable speed agitator with hollow shaft for injection of gases into material • Water cooled stuffing box • Sight glasses and other extra connections.

REFLUX CONDENSER: Arranged to operate in any position. Additional condenser may be hooked up for use as a still.

RECEIVER AND DECANTER: Again, stainless steel for all interior surfaces.

The unit shown is just one of **p-k**'s line of *standardized* pilot plants and autoclaves of 5, 10 and 15 gallon capacity and up. Each provides a wide range of temperatures and pressures for flexible operation. Heating is by steam or electricity. Internal surfaces are stainless steel.



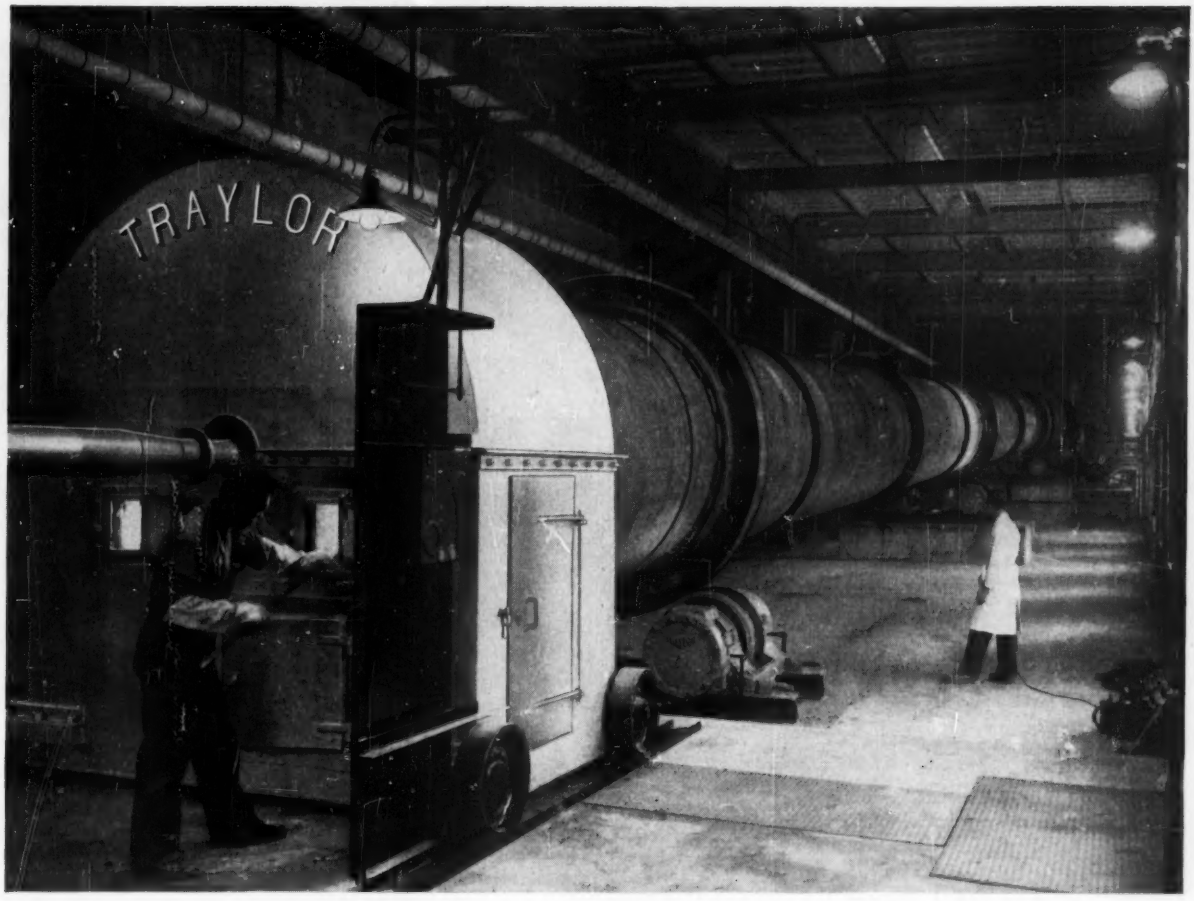
Want a quotation? We'll send complete specifications on a pilot plant for you, plus a catalog on **p-k**'s wide line of research, development and production equipment for the processing industries. Write today.

The Patterson-Kelley Co., Inc., 170 Lackawanna Avenue, East Stroudsburg, Pa.

PATTERSON-KELLEY

2540 A

Offices: 101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities



the Personal Touch of a Traylor Engineer

WILL PAY DIVIDENDS IN YOUR ROTARY KILN OPERATION

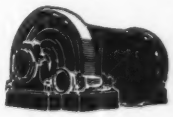
A Traylor engineer makes it his business to keep in touch with every Traylor Rotary Kiln. His periodic visits usually result in a better product, reduced operating costs, or increased production with your Traylor Kiln.

"Keeping in touch" is routine at Traylor. That's why so many of the world's leading Chemical processors return time after time for additional "Traylor-made" kilns to handle their thermo-processing requirements. Get in touch with Traylor if you need advice on profitable Rotary Kiln operation.

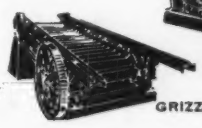

PRIMARY GYRATORY CRUSHERS


ROTARY KILNS, COOLERS, SLAKERS


SECONDARY GYRATORY CRUSHERS


GRINDING MILLS


JAW CRUSHERS


APRON AND GRIZZLEY FEEDERS

TRAYLOR ENGINEERING & MFG. CO.
761 Mill St., Allentown, Pa.
Canadian Mfrs.: Canadian Vickers, Ltd., Montreal, P. Q.

A Traylor leads to greater profits

SEND FOR BULLETINS
. . . just mention the Traylor Equipment that interests you.

SALES OFFICES • NEW YORK • CHICAGO • SAN FRANCISCO

Is your waste line getting too expensive?

You may be able to reduce it with corrosion-resistant Republic SRK



Here's your opportunity to cut periodic and costly pipe replacement. It's a new, rugged plastic pipe—Republic's Semi-Rigid Kralastic. Equally useful in both waste and process lines, it is highly resistant to an impressive list of corrosive liquids and gases (see chart).

Within its temperature and pressure limitations, Republic Semi-Rigid Kralastic should prove ideal for many applications in the food processing and chemical industries. Extremely tough, it will absorb punishment without breaking or shattering. Here are more advantages:

Lightweight . . . It's easy to handle, transport and install. Three 20-foot lengths of 4″ Kralastic can be carried by one man.

Easy to Cut . . . Only tool needed is an ordinary handsaw or hacksaw. Pipe can be cut while being held across knee.

Easy to Join . . . Takes only a minute or two. Simply brush on special solvent. A wide variety of plastic fittings is available.

Low Friction Loss . . . Smooth interior surface permits high rate of flow, reduces friction loss, minimizes clogging.

Non-Toxic . . . It's made from virgin materials. This permits transmission of fluids for human or animal consumption.

Immune to Sunlight . . . Carbon-black additive provides protection from ultraviolet rays.

Combines with Steel . . . Special fittings permit easy connection with steel pipe.

Modern techniques and highest standards of quality control result in wall sections of uniform strength throughout each length. Republic Semi-Rigid Kralastic comes in three working pressures—with specific sizes for each (straight lengths only). Pipe of 150 lb. rating comes in sizes ½″ through 2″; pipe of 100 lb. rating is available in sizes 2″ through 6″; 75 lb. rated pipe is made in 3″, 4″ and 6″ sizes. Republic Steel also supplies Semi-Rigid Butyrate and Flexible Polyethylene. If you have a problem, write us. We will recommend the proper material for your job. Send coupon for literature.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
3116 East 45th Street
Cleveland 27, Ohio

Please send more information on:

☐ Republic Semi-Rigid Kralastic ☐ ENDURO® Stainless Steel

☐ Dekoron®-Coated E. M. T. ☐ Steel Barrels and Drums

Name_____ Title_____

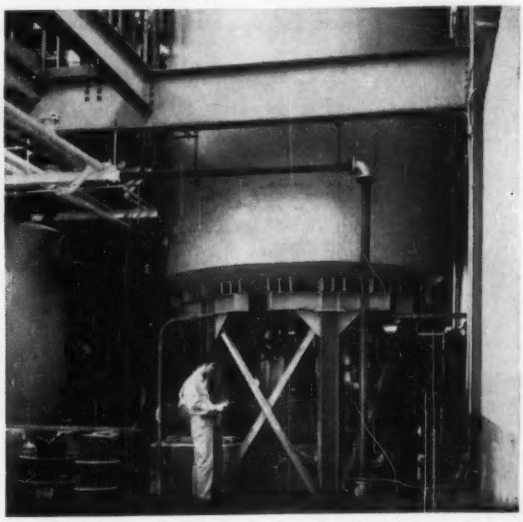
Company_____

Address_____

City_____ Zone____ State_____

K-8721





FREEDOM FROM CORROSION makes ENDURO Stainless Steel Equipment your best buy. Equipment made from ENDURO, like this penicillin fermentation tank, stays on the job, requires minimum maintenance, lasts long. ENDURO protects purity and chemistry from contamination and side reactions. It's easy to keep clean and attractive. Republic will help you and your equipment suppliers apply ENDURO's qualities and benefits efficiently and economically.

CHEMICAL RESISTANCE CHART RATINGS

E—No attack. G—Appreciably no attack. N—Badly attacked.
F—Some attack but usable in some instances. C—Cold—77°F.
P—Attacked—not recommended. H—Hot—170°F.

ACIDS	C	H
Acetic, 10%	E	E
Acetic, glacial	N	N
Benzene sulfonic	E	E
Benzoic	E	E
Boric	E	E
Butyric	N	N
Chloroacetic	N	N
Chromic, 10%	E	N
Chromic, 50%	F	N
Citric	E	E
Fatty Acids	E	E
Fluosilicic	E	E
Formic, 90%	N	N
Hydrobromic	E	F
Hydrochloric	E	F
Hydrocyanic	E	E
Hydrofluoric	E	F
Hypochlorous	E	F
Lactic	E	F
Maleic	E	E
Nitric, 5%	G	N
Nitric, 20%	F	N
Nitric, 40%	N	N
Oleic	E	E
Oxalic	E	E
Perchloric	E	F
Phosphoric	E	F
Picric	E	E
Stearic	E	E
Sulfuric, 50%	E	E
Sulfuric, 70%	G	N
Sulfuric, 93%	N	N
Oleum	N	N
Mixed Acids 57% H_2SO_4 28% HNO_3	N	N

ALKALIES		
Ammonium hydroxide	E	E
Calcium hydroxide	E	E
Potassium hydroxide	E	E
Sodium hydroxide	E	E

ACID SALTS		
Alum or Aluminum sulfate	E	E
Ammonium chloride, nitrate, sulfate	E	E
Copper chloride, nitrate, sulfate	E	E
Ferric chloride, nitrate, sulfate	E	E
Nickel chloride, nitrate, sulfate	E	E
Stannic chloride	E	E
Zinc chloride, sulfate	E	E

NEUTRAL SALTS	C	H
Calcium chloride, sulfate	E	E
Magnesium chloride, sulfate	E	E
Potassium chloride, sulfate	E	E
Sodium chloride, sulfate	E	E

GASES		
Chlorine, wet	E	N
Chlorine, dry	E	F
Sulfur dioxide, wet	E	E
Sulfur dioxide, dry	E	E

ORGANIC MATERIALS		
Acetone	N	N
Alcohols, methyl, ethyl	E	P
Aniline	N	N
Benzene	N	N
Carbon tetrachloride	N	N
Chloroform	N	N
Ethyl Acetate	N	N
Ethylene dichloride	N	N
Formaldehyde, 37%	E	E
Phenol, 5%	G	F
Refinery crudes	E	E
Trichloroethylene	N	N

PAPER MILL APPLICATIONS		
Kraft liquor	E	F
Black liquor	E	F
Green liquor	E	F
White liquor	E	F
Sulfite liquor	E	F
Chlorite bleach	E	P
Alum	E	E

PHOTOGRAPHIC INDUSTRY		
Developers	E	E
General use	E	E
Silver nitrate	E	E

FERTILIZER INDUSTRY		
General use	E	F

STEEL INDUSTRY		
Sulfuric acid pickling	E	E
Hydrochloric acid pickling	E	E
H_2SO_4, HNO_3 pickling	N	N

TEXTILE INDUSTRY		
General use	E	E

FOOD INDUSTRY		
General use	E	E
Breweries	E	E
Dairies	E	E

NOTE: This chart is offered as a guide only and is based on tests which we believe to be reliable. However, it is suggested that the user check SRK for chemical resistance in the application for which it is intended.



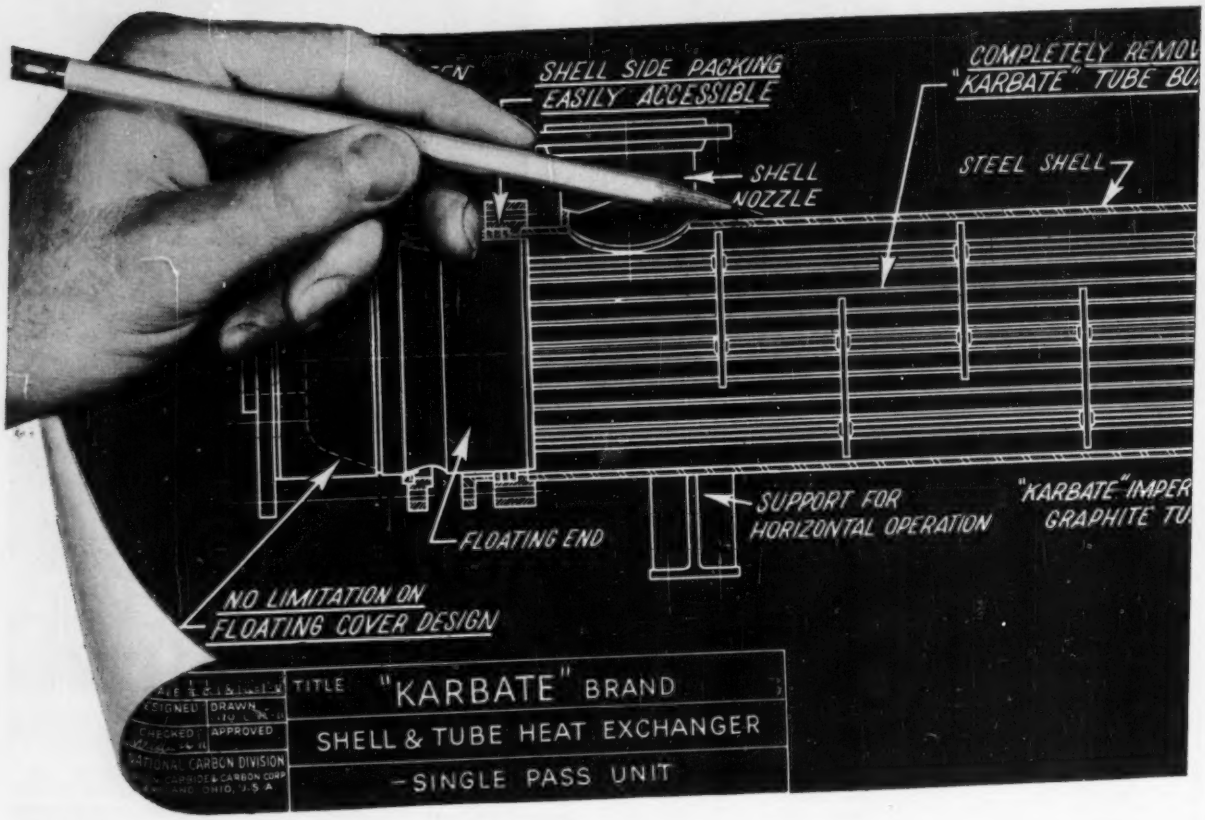
IN VERY SEVERE CORROSIVE CONDITIONS Republic Dekoron-Coated E.M.T. protects electrical raceways. Its tough, polyethylene coating over the galvanized finish gives double protection. Moisture-tight joints are easily made, using threadless connectors and couplings. Joints are sealed with tape. Dekoron-Coated E.M.T. provides an economical, maintenance-free raceway that resists corrosion and reduces costs.



NO CONTAMINATION—NO SPOILAGE. Republic Steel offers a full range of barrels, drums and pails in a variety of metals and finishes to protect your products. Choose from ENDURO Stainless Steel, hot dipped galvanized steel, hot dipped tinned steel, mill galvanized sheet steel, hot rolled open hearth steel, plain or lacquer lined. Choice of gages to meet all handling and shipping requirements. Many styles in sizes up to 55 gallons.

ANNOUNCING...NATIONAL CARBON'S COMPLETE LINE OF

"KARBATE" IMPERVIOUS BRAND



HERE'S WHAT YOU GET WITH "KARBATE" STANDARD HEAT EXCHANGERS:

- **LOWER FIRST COST**... through quantity production
- **MORE AREA PER UNIT**... to 2300 square feet per tube bundle
- **CHOICE OF TUBE LENGTHS**... 6, 9, 12, 14, 16 feet
- **FASTER DELIVERY**... from extensive factory stocks

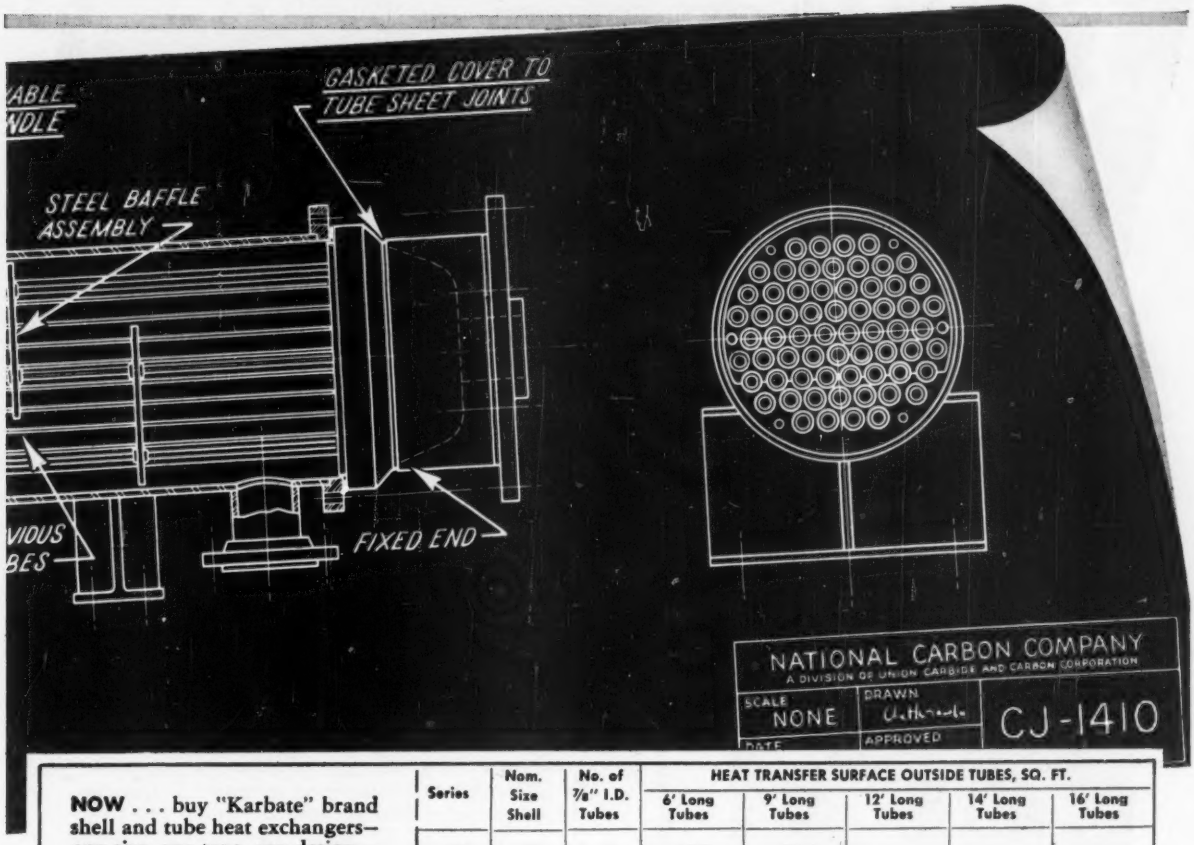
...and all the advantages of "Karbate" Impervious Graphite, including:

- **COMPLETE CORROSION RESISTANCE**
- **HIGH THERMAL CONDUCTIVITY**
- **IMMUNITY TO THERMAL SHOCK**

Engineered for maximum corrosion resistance and minimum maintenance, these shell and tube heat exchangers are so constructed that all surfaces in contact with the corrosive fluid are of "Karbate" brand impervious graphite. Their mechanical design, proved in years of service, utilizes the material's high compressive strength to assure ruggedness beyond the toughest operating requirements.

Always consider "Karbate" brand impervious graphite. Take full advantage of this versatile material by including "Karbate" heat exchange equipment in every estimate where corrosion-resistance is a factor. And when you do this, you'll be pleasantly surprised at the cost comparison with heat exchangers of materials having far less effective resistance to corrosion.

GRAPHITE HEAT EXCHANGERS



NOW . . . buy "Karbate" brand shell and tube heat exchangers—any size, any type, any design—directly from National Carbon, pioneer and leader in the field of corrosive heat transfer.

Components of all sizes of "Karbate" Brand Heat Exchangers are manufactured in quantity and carried in stock. You save money...you save time...when you specify "Karbate" Brand Shell and Tube units.

Series	Nom. Size Shell	No. of 7/8" I.D. Tubes	HEAT TRANSFER SURFACE OUTSIDE TUBES, SQ. FT.				
			6' Long Tubes	9' Long Tubes	12' Long Tubes	14' Long Tubes	16' Long Tubes
90	6"	9	17.7	26.5	—	—	—
310	10"	31	—	91.2	121.6	141.9	162.2
420	14"	42	81.7	123.3	164.8	192	220
640	16"	64	124.3	187.7	251	293	335
850	18"	85	165.2	250	334	389	444
1090	20"	109	213	320	427	499	570
1350	22"	135	263	397	530	618	706
1630	24"	163	317	479	640	746	852
1950	26"	195	379	573	766	892	1017
2330	28"	233	453	684	914	1166	1217
2680	30"	268	521	786	1051	1225	1400
3490	34"	349	679	1024	1368	1595	1822
4390	38"	439	855	1289	1722	2009	2295

"KARBATE" BRAND IMPERVIOUS GRAPHITE IS MANUFACTURED EXCLUSIVELY BY NATIONAL CARBON COMPANY

Remember, whenever you are buying corrosion resistant heat exchangers, that it will pay you to get our proposal on "Karbate" brand Heat Exchangers!

•

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco
IN CANADA: Union Carbide Canada Limited, Toronto

IMPERVIOUS GRAPHITE
KARBATE
TRADE-MARK
PROCESS EQUIPMENT
NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation

WRITE FOR NEW CATALOG SECTION S-6800



ON ALL NEW RELIANCE A-C. MOTORS

All new Reliance A-c. Motors provide these two essentials to trouble-free operation in hazardous or corrosive atmospheres . . .

POSITIVE PROTECTION

A pure neoprene gasket encloses each lead wire with an individually molded pressure knob. This gasket forms a positive protective seal between the motor frame and the corrosion-proof, cast iron conduit box.

POSITIVE IDENTIFICATION

Numbers on the pressure knobs and lead lugs correspond with a numbered wiring diagram on the stainless steel nameplate. Identification for installing or rewiring is positive and easy.

Another Reliance engineered development to assure industry a Totally-Protected, Precision-Built Motor!

Get in touch with your nearest Reliance sales office or distributor, or write for bulletin B-2401. *Reliance Electric & Engineering Co., 1063 Ivanhoe Road, Cleveland 10, Ohio; Canadian Division — Welland, Ontario.*

B-1497

RELIANCE ELECTRIC AND ENGINEERING CO.

ADVERTISEMENT—*This entire page is a paid advertisement* *Prepared by U. S. Industrial Chemicals Co.*

U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

U.S.I. ISOSEBACIC* ACID OFFERED FOR EVALUA

New Synthetic Chemical Now Available in P

U.S.I. Isosebacic acid, a new synthetic organic che ...o-duced in pilot plant quantities for evaluation by rese... ...pment groups throughout the chemical industry.

This new product is a mixture of isomers of sebacic acid in the proportions indicated below and promises to be of great interest to users of dibasic acids in general. The product of more than three years of intensive research in laboratory and pilot plant, U.S.I. Isosebacic acid is produced by a novel synthetic process, starting from metallic sodium and butadiene. Both of these raw materials are readily available in large quantities and have a long history of price stability. Although U.S.I. Isosebacic acid is currently priced at 45 cents per pound for development quantities, it is expected that large scale production in a commercial plant will make substantial price reductions possible in the future.

Many promising uses

One of the most promising uses for U.S.I. Isosebacic acid is the manufacture of high quality plasticizers for vinyl resins, particularly where low temperature flexibility is required. U.S.I. Isosebacic acid esters of isooctyl alcohol or 2-ethylhexanol have been found to have superior properties in this

MORE

U.S.I. Assumes New Responsibility

National Distillers Products Corporation recently announced that all chemical operations of the company will be conducted by the U. S. Industrial Chemicals Co. Division. Previously U. S. Industrial Chemicals Co. was part of the Chemical Division of National Distillers. The two have now been consolidated under the U.S.I. name.

The organization and name of National Petro-Chemicals Corporation, 60% owned subsidiary, will remain unchanged. "Petro" will continue to be managed by National Distillers, now through U.S.I.

Warts Successfully Treated with Oral Methionine

Recent work in the United States has confirmed the fact that methionine can be used to treat warts. The American work confirms previous findings to the same effect made in France. Patients with warts were given methionine orally at the rate of 1 to 2 grams per day. The warts usually disappeared within ten days after treatment began. This effect of methionine was discovered accidentally when a patient with warts was given methionine for hepatitis. During the course of treatment, the warts disappeared.

Anhydrous Ammonia Reported Useful as a Fungicide

Recently completed research indicates that in addition to its primary use as a fertilizer, anhydrous ammonia also acts as a fungicidal agent in the soil. The researchers found that only 0.6% of the nematodes and 4.9% of the fungi survived when 608 ppm of nitrogen were present in the soil. This level of ammonical nitrogen is reported to occur regularly in the retention zone when anhydrous ammonia is applied to fields.

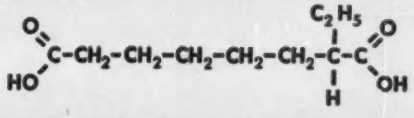
Although the numbers of nematodes and fungi were reduced by levels of ammonical nitrogen as low as 136 ppm, the largest reduction in both nematodes and fungi occurred when levels were above 365 ppm.

New Polyethylene Booklet

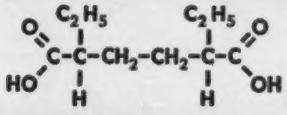
U.S.I. has just issued a booklet on PETROTHENE polyethylene resins as raw materials for the plastics processor. PETROTHENE is offered in pellet form in both high quality and general purpose resin types. The booklet describes the product, its properties, production, uses, methods of processing (extrusion, injection and compression molding) and fabricating. U.S.I. services to the plastics processor are outlined. Copies on request.

U. S. I. ISOSEBACIC* Acid a mixture of C_{10} Dicarboxylic Acids

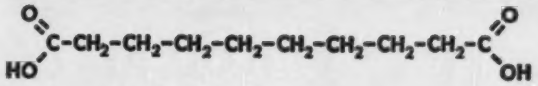
α ethyl suberic acid 72 - 80%



α,α' diethyl adipic acid 12 - 18%



sebacic acid 6 - 10%



*TRADE MARK

U.S.I. CHEMICAL NEWS

CONTINUED

U.S.I. Isosebacic Acid

respect. These same esters also show great promise as base materials for the synthetic lubricating oils now required by jet aircraft engines. Especially important for such a national defense application is the fact that U.S.I. Isosebacic acid will be produced entirely from domestic raw materials which are in ample supply.

For polymeric plasticizers

Polymeric plasticizers, made from glycols and long chain dibasic acids, are another promising application for U.S.I. Isosebacic acid. Because of their superior low volatility and non-migration properties, polymeric plasticizers have become increasingly popular with vinyl resin converters and compounders in recent years. The availability of U.S.I. Isosebacic acid will make possible development of new and cheaper polymeric plasticizers.

Seen useful for polyesters

U.S.I. Isosebacic acid will also be of interest to producers of polyesters for coupling with diisocyanates in the production of polyurethane foams, elastomers, adhesives and surface coatings. Other polyesters, made from U.S.I. Isosebacic acid and glycols also show promise as raw materials in the production of resins for reinforced plastics.

There are many other applications where U.S.I. Isosebacic acid may be used. Samples are available for evaluation on laboratory or pilot plant scale. For samples, data sheets and technical assistance, write to the Editor, U.S.I. Chemical News.

Urethan a Synergist In Retarding Cancer

Recent experimental evidence indicates that urethan combined with nitrogen mustard compounds or triethylene melamine may inhibit cancerous growths which do not respond to these materials used alone. Such findings have been observed in animals with experimental tumors, and there are indications that there may be regressions of some human tumors from such action. It is emphasized, however, that the remissions so induced are of a temporary nature. Additional studies are being conducted further to evaluate this treatment and its side reactions.

Metallic Sodium Purifies Petroleum . . . Product Recovery High

It has been established that the treatment of petroleum fractions with metallic sodium has several beneficial effects. All types of sulfur compounds are removed, particularly thiophenic sulfur, difficult to eliminate with other treating agents.

In addition to desulfurizing, sodium improves odor, color, and storage stability, and reduces "dissolved" gum-formers. The sodium treating process has the advantage of producing a high-quality product with little loss of volume.

Sodium in one of the finely divided forms developed by U.S.I. — sodium dispersions in inert hydrocarbon media, or sodium coated on inert solid particles — are especially suitable for this application. Both of these procedures are easy to use, and little additional equipment is needed. Specialty solvent and oil manufacturers find this treatment particularly attractive.

New Film Shows Advantages of Ohio as Plant Site

The Cleveland Electric Illuminating Company has produced a 28-minute sound film in color called "Land of Promise," which outlines the recent rapid growth of industry in Northeast Ohio. The film indicates that chemical enterprises in particular have been drawn by the nearness of plentiful power, water, labor, land, materials and markets. And the finalizing of plans for the St. Lawrence Seaway now holds forth the promise of direct access to *world* markets and materials.

Among the plants which located early in the area and attracted other producing units to it can be numbered the U.S.I. sodium plant at Ashtabula. Since its startup in 1950, units have been constructed by other companies at Ashtabula which use U.S.I. metallic sodium and chlorine.

The film can be obtained for showings from Cleveland Electric Illuminating Company at 83 Public Square, Cleveland.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

For testing interior temperatures of products during processing, new temperature indicators, consisting of heat-sensitive papers sealed in glass tubes, are available. At a predetermined point, the paper changes from white to black irreversibly, leaving a permanent record. **(No. 1090)**

A new silicone mold release emulsion for rubber, plastics and metal is more stable to creaming or separation than any comparable silicone developed thus far. **(No. 1091)**

Polyethylene squeeze bottles now feed a new type ink to recording instrument pens. A plastic capillary-tube spout on the bottle pinpoints a precise quantity of ink onto the pen without dripping. **(No. 1092)**

A rubber compound for sealing high vacuum equipment, recently developed, has good resistance to out-gassing at high temperatures, and long service life. It is a formula of Buna N Polymer, moldable in special and standard shapes. **(No. 1093)**

Alcohol-saturated cotton sponges may now replace the bottle of alcohol and the box of cotton in the doctor's bag. The sponges come in jars of 30, 150 and 250; also contain other disinfectants. **(No. 1094)**

A rust remover, shipped in powdered form, is proving unusually effective for ferrous and nonferrous metals. Mixed with water to any desired strength, it is fast-acting, nontoxic, nonflammable, leaves a thin, rust-resistant coat. **(No. 1095)**

A new plastic foam can be produced in lighter densities than other foams, making it suitable for lightweight product uses. It has high tensile, tear and compression qualities excellent for cushioning heavy loads. **(No. 1096)**

Bursting strength of polyethylene pipe tends to increase with higher loadings of carbon black, according to preliminary tests. If the findings prove valid, the plastic pipe might substitute for steel in many applications. **(No. 1097)**

To protect feet against temperature extremes, a new safety shoe has been developed. The upper is padded with foamed vinyl containing countless "sealed-air" bubbles. The vinyl does not absorb moisture, oil or odors. **(No. 1098)**

A new type laboratory rod support is now offered which attaches to any vacant space along a lattice rod without disturbing apparatus already set up. From the clamp another rod can be extended to support additional apparatus. **(No. 1099)**

PRODUCTS OF U.S.I.

ALCOHOLS
- Butanol (Normal-Butyl Alcohol)
- Fusel Oil — Refined

Ethanol (Ethyl Alcohol)
- Specially Denatured—all regular and anhydrous formulas
- Completely Denatured—all regular and anhydrous formulas
- Pure—190 proof U. S. P., Absolute—200 Proof
- Filmex*—special proprietary solvent
- Solox*—proprietary solvent—regular and anhydrous

ETHERS
- Ethyl Ether, U. S. P.
- Ethyl Ether, Absolute—A.C.S.

ACETONE—A.C.S.

ANSOLS
- Ansol* M
- Ansol* PR

ACETIC ESTERS
- Butyl Acetate
- Ethyl Acetate—all grades
- Normal-Propyl Acetate

OXALIC ESTERS
- Diethyl Oxalate

OTHER ESTERS
- Diatol*
- Diethyl Carbonate

INTERMEDIATES
- Acetoacetanilide
- Acetoacet-ortho-chloroanilide
- Acetoacet-ortho-toluidide
- Acetoacet-para-chloroanilide
- Ethyl Acetoacetate
- Ethyl Benzoylacetate
- Ethyl Sodium Oxalacetate

FEED PRODUCTS
- Calcium Pantothenate (Feed Grade)
- Choline Chloride Products
- Curbay B-G* 80
- DL-Methionine (Feed Grade)
- Niacin, U.S.P.
- Riboflavin Concentrates
- Special Liquid Curbay*
- U.S.I. Vitamin B_{12} and Antibiotic Feed Supplements
- Vacatone* 40
- Vitamin A, D_3, and K_3 Products

PLASTICS
- Petrothene** Polyethylene Resins

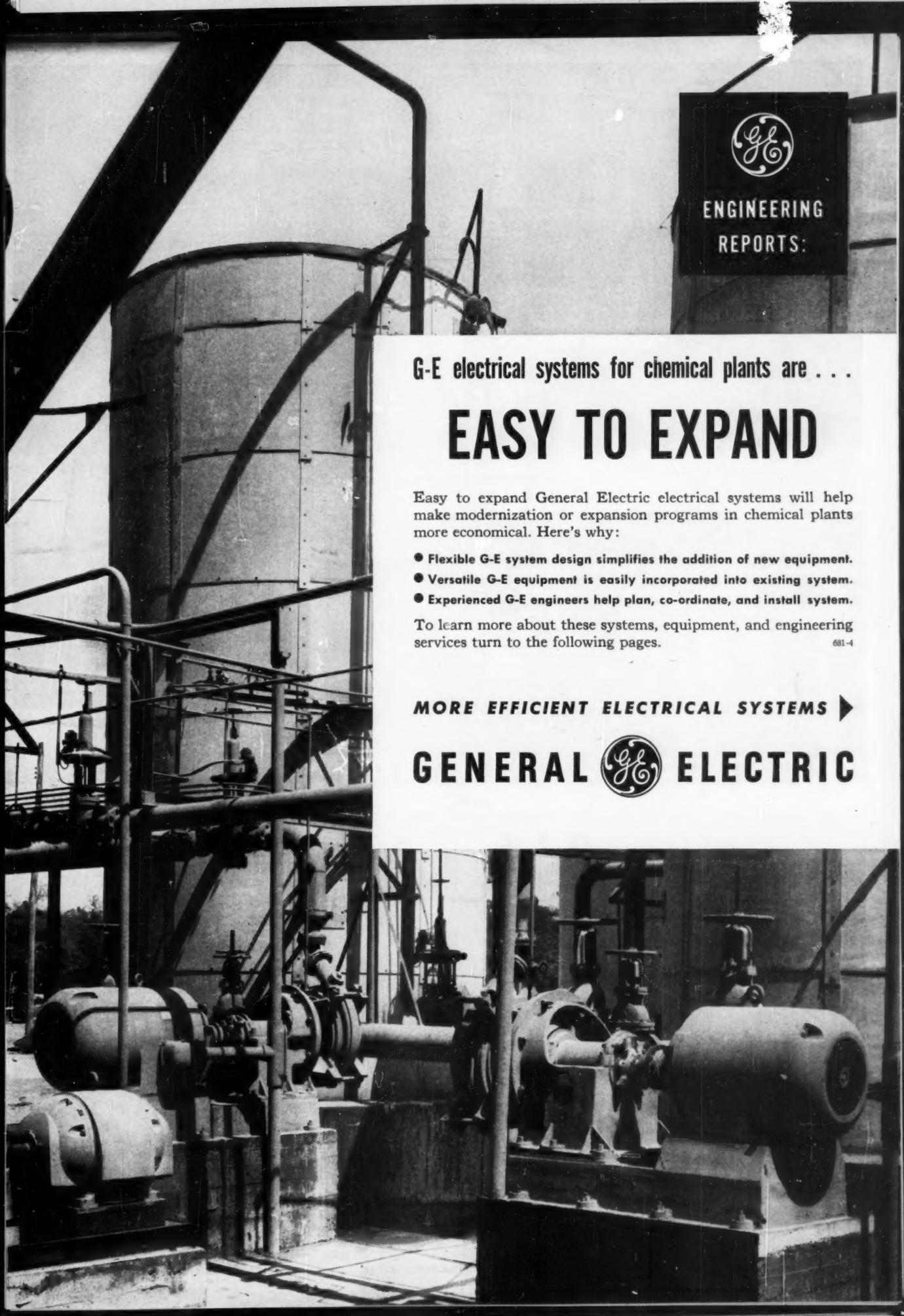
OTHER PRODUCTS
- Anhydrous Ammonia
- Caustic Soda
- Ethylene
- Liquid Chlorine
- Metallic Sodium
- DL-Methionine (Pharm.)
- N-Acetyl DL-Methionine
- Nitrogen Solutions
- Propionic Acid
- Sulfuric Acid
- Urethan, U.S.P.

*Reg. U.S. Pat. Off.
**Reg. Pend.

U.S. INDUSTRIAL CHEMICALS CO.

Division of National Distillers Products Corporation

99 PARK AVENUE, NEW YORK 16, N. Y. BRANCHES IN ALL PRINCIPAL CITIES



G-E electrical systems for chemical plants are . . .

EASY TO EXPAND

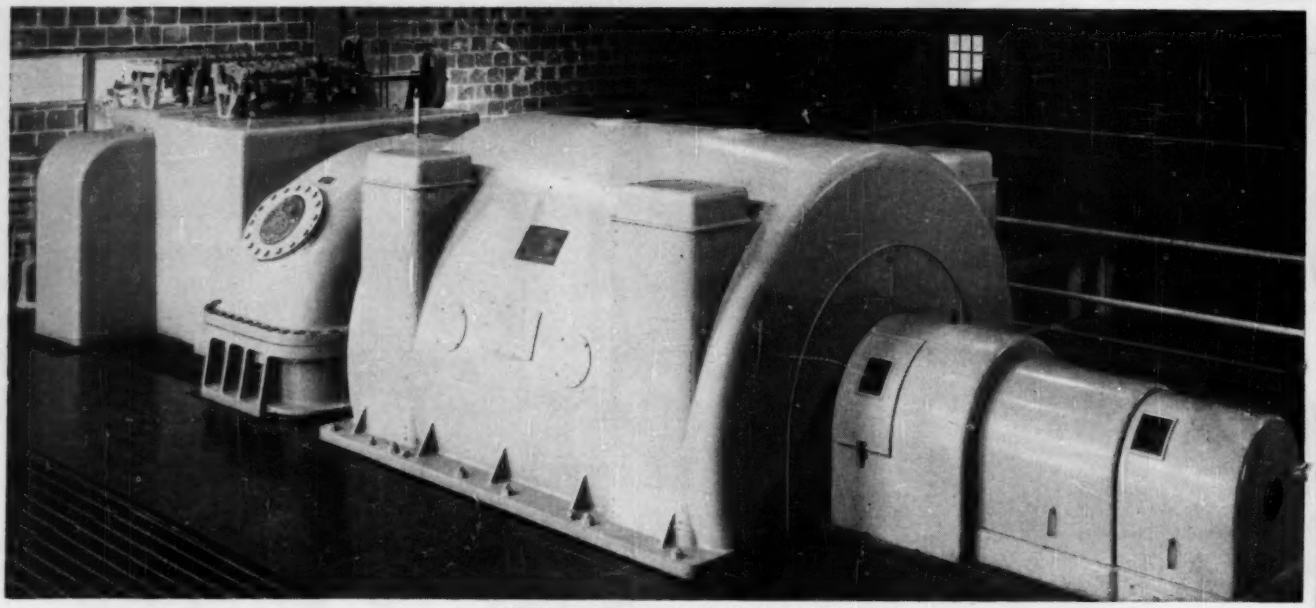
Easy to expand General Electric electrical systems will help make modernization or expansion programs in chemical plants more economical. Here's why:

- **Flexible G-E system design simplifies the addition of new equipment.**
- **Versatile G-E equipment is easily incorporated into existing system.**
- **Experienced G-E engineers help plan, co-ordinate, and install system.**

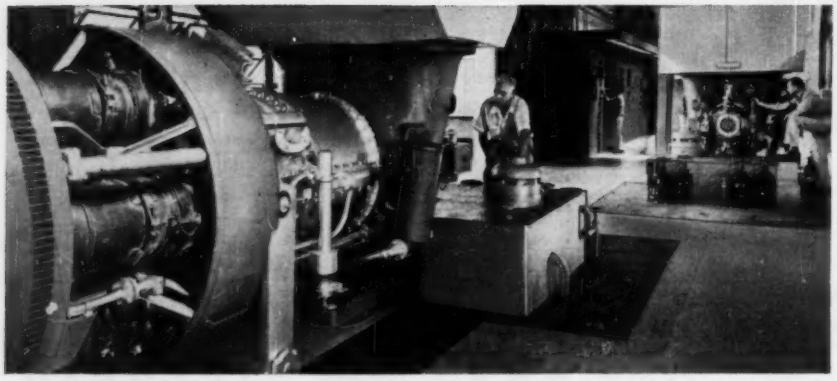
To learn more about these systems, equipment, and engineering services turn to the following pages. 681-4

MORE EFFICIENT ELECTRICAL SYSTEMS ▶

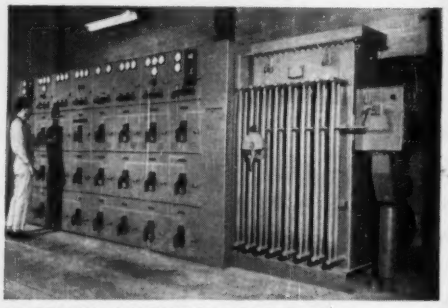
GENERAL ELECTRIC



UTILIZING PROCESS STEAM, G.E.'s complete range of steam turbine-generators provide electric power as a by-product, help maintain plant steam balance.



DEPENDABLE G-E gas turbines range from 6700 to 17,000 hp. More than 55 units utilize exhaust heat for power generation and mechanical drive applications.



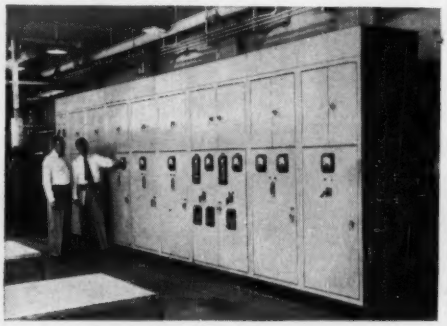
FACTORY ASSEMBLED G-E load center unit substations help cut installation time.



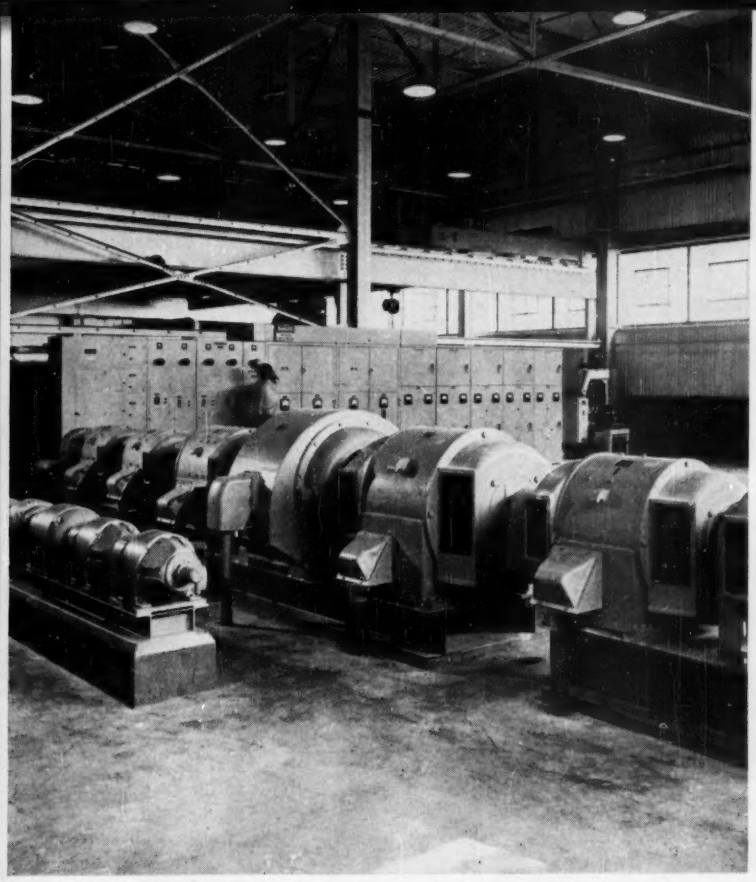
COMPLETE, COMPACT, G-E motor control centers provide centralized control in load areas.



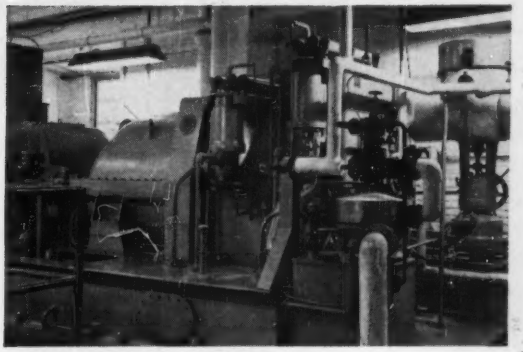
MORE RELIABLE POWER DISTRIBUTION is available with G-E package substations which use co-ordinated transformers, metal-clad switchgear.



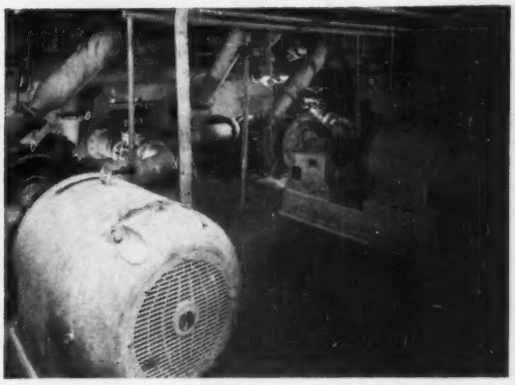
SAVE FLOOR SPACE with compact G-E Limit-amp control units.



DEPENDABLE G-E d-c motor generator sets are designed to operate in continuous service at top efficiency. Minimum of maintenance is a key feature of these sturdy generators built for long life.



ECONOMICAL MAINTENANCE is a key feature in design of G-E mechanical drive turbines.



RUGGED CONSTRUCTION of G-E Tri-Clad* motors make them ideal for all types of drive operations. Polyex insulation in motors 100–3000 hp gives 50% longer motor life. *Reg. Trademark of General Electric Co.

G-E engineering services, equipment can give you . . .

More efficient electrical systems

MODERNIZING, EXPANDING, BUILDING? Whatever your plans, let experienced G-E engineers help plan a more efficient electrical system for you. They will work with you or your engineering contractors to give you correct answers to the following questions.

SHOULD YOU GENERATE OR PURCHASE POWER? G-E engineers will help make a "load" survey of your facilities, and recommend an economical solution to your particular power supply problem.

WHAT TYPE ELECTRICAL DISTRIBUTION SYSTEM SHOULD YOU INSTALL? The latest distribution system concepts will be reviewed with you by G-E engineers. They will help select and design a modern system to meet your individual requirements.

WHAT KIND OF DRIVE EQUIPMENT SHOULD YOU USE? Each application for drives in your processing lines will be individually examined by G-E engineers to assure that the proper drive is designated for the job.

WHERE CAN YOU UTILIZE AUTOMATIC CONTROLS? New developments in the field of automatic controls will be applied throughout your processing lines by G-E engineers.

Let your General Electric Apparatus Sales Representative get you detailed answers to these and other electrical questions. Contact him at your nearest G-E Apparatus Sales Office early in your planning stages. General Electric Company, Schenectady 5, N. Y. 681-3

PROTECT YOUR EQUIPMENT INVESTMENT ▶

Engineered Electrical Systems for Process Industries

GENERAL ELECTRIC



SIX G-E ENGINEERING SERVICES . . .

HELP YOU PROTECT YOUR EQUIPMENT INVESTMENT

1 **G-E APPLICATION ENGINEERING** helps you and your consultants design the right electric system for your plant.

2 **G-E ANALYTICAL ENGINEERING** helps attain the optimum electrical system for your application. Engineering experience backed up by electronic system analyzers save valuable design time.

3 **G-E PRODUCT DEVELOPMENT** laboratories design and test new equipment under tomorrow's conditions to meet your future demands.

4 **G-E FIELD-SERVICE ENGINEERING** helps you supervise installation, expedite start-up of your major electric equipment.

5 **G-E MAINTENANCE SERVICE** from 31 G-E Service Shops will repair and uprate your old equipment, help establish productive maintenance of your equipment, furnish emergency service.

6 **G-E PROJECT CO-ORDINATION** means on-time engineering, shipment, installation of your electric equipment from preliminary diagrams through start-up.

These valuable services are available to you with General Electric equipment. Contact any General Electric Apparatus Sales Office. Meanwhile, for the full story of G-E engineering services, write for brochure GED-2244, General Electric Co., Sect. 681–3, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

it's **boiler check-up** time!



Yarway Seatless Tandem Blow-Off Valve—angle-straightway combination.

HOW ARE YOUR BLOW-OFF VALVES?

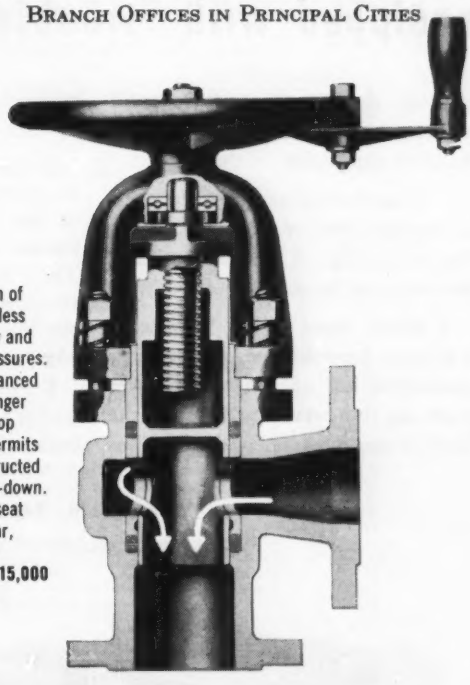
Are they drop-tight? Rugged and dependable? Easy to maintain?

Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

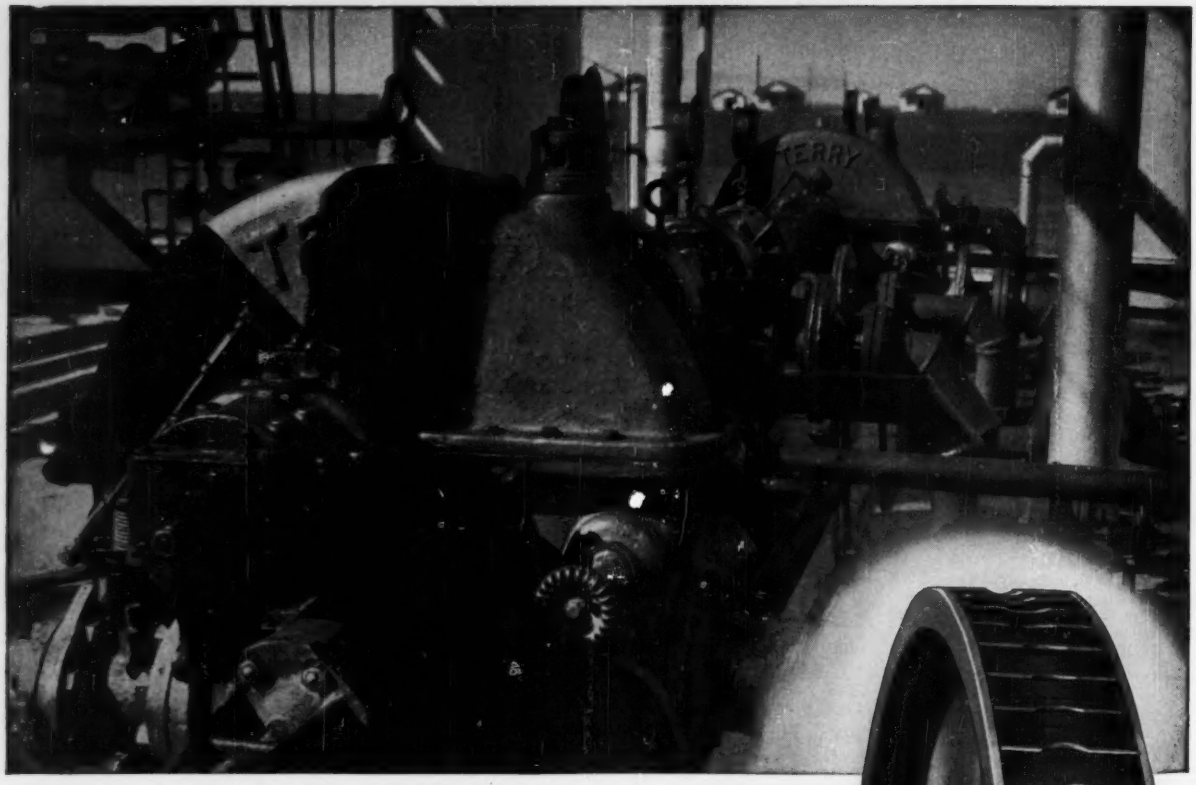
Write today for free YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 for higher pressures.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Cross-section of Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals drop tight—yet permits free, unobstructed flow in blow-down. There is no seat to score, wear, clog or leak. **Used in over 15,000 boiler plants.**

YARWAY blow-off valves



Two Terry Turbines equipped with "trouble eliminators"

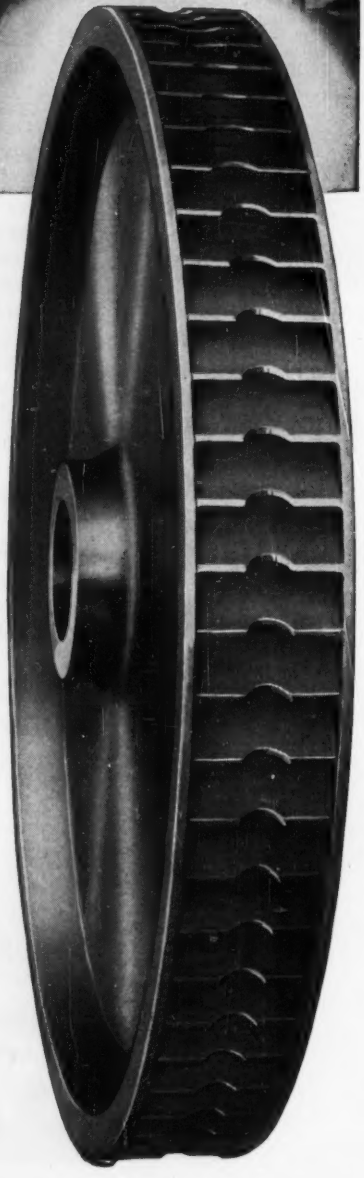
Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.



THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1159

In the World of Plastics a Star is Born!

MARLEX*

Called "the greatest advance in plastics since 1939" MARLEX opens entire new areas of application.

MARLEX, a revolutionary new family of plastics developed by Phillips Petroleum Company scientists, is opening a new era in plastics technology. It represents what is probably the most important forward stride in plastics development since the first commercial production of polyethylene in 1939.

MARLEX is a *new kind* of "polyethylene" . . . tougher, stronger and more versatile than any conventional polyethylene now available. Members of the MARLEX family range from an exceptionally rigid, highly crystalline ethylene polymer to more flexible materials of lower crystallinity. MARLEX permits manufacture of stronger products with less material. Under identical test conditions, the tensile strength of MARLEX 50 exceeds 4,500 pounds per square inch against less than 2,000 pounds per square inch for a typical present-day polyethylene. It does not soften at temperatures as high as 250° F. It will not become brittle at temperatures as low as 175° F. below zero. The ability of MARLEX to withstand heat, and its superb resistance to penetration by moisture, gases, oils and chemicals provide outstanding protection in plastic packages, bottles, tubes and bags.

MARLEX 50 has been used and evaluated by many leading fabricators who report that it opens the way to new applications in the plastics field, and also will find wide usage in many products now made of other materials. They say it colors, molds and extrudes beautifully.

MARLEX is manufactured by a truly revolutionary process. Instead of using high temperatures and pressures in the polymerization reaction, MARLEX is made by a continuous process using a catalyst and operating at low pressure and temperature. This results in economies and precise control of quality and uniformity, and also permits the production of a whole series of new plastics tailored for the needs of specific applications.

The huge demand for MARLEX cannot be satisfied at this time. But, with the construction of a new plant of greater than 100 million pounds per year capacity by Phillips Chemical Company, a wholly owned subsidiary of Phillips Petroleum Company, fabricators of plastics will soon have substantial supplies available. MARLEX will later be made by other manufacturers who will be licensed to use the Phillips process.

Today, the biggest thing ahead in plastics is MARLEX. Forward looking manufacturers of plastic products are making their plans accordingly.

MARLEX 50

Typical Properties	Value	ASTM Test
Softening Temperature, °F	260[a]	—
Density	0.96	—
Tensile Strength, psi		
Injection Molded		D638-52T
20 in/min	5100	
0.2 in/min	3500[b]	
Compression Molded		D412-51T
20 in/min	4200	
0.2 in/min	3100[b]	
Elongation, %		
Injection Molded		D638-52T
20 in/min	28	
0.2 in/min	518[b]	
Compression Molded		D412-51T
20 in/min	20	
0.2 in/min	1175[b]	
Stiffness, psi	140,000	D747-50
Melt Index	0.6	D1238-52T
Impact Strength, Izod (ft lbs/in notch)	3.0	D256-47T
Brittleness Temperature, °F	−180	D746-52T
Moisture Vapor Transmission, (Method A at 100° F) gms/100 sq in/mil/24 hrs	0.3	D697-42T

[a] Adapted from method of Karrer, Davis and Dieterich, *Ind. and Eng. Chem. (Anal. Ed.)* **2**, 96 (1930).

[b] Test specimens did not break when pulled to the limit of the testing machine.

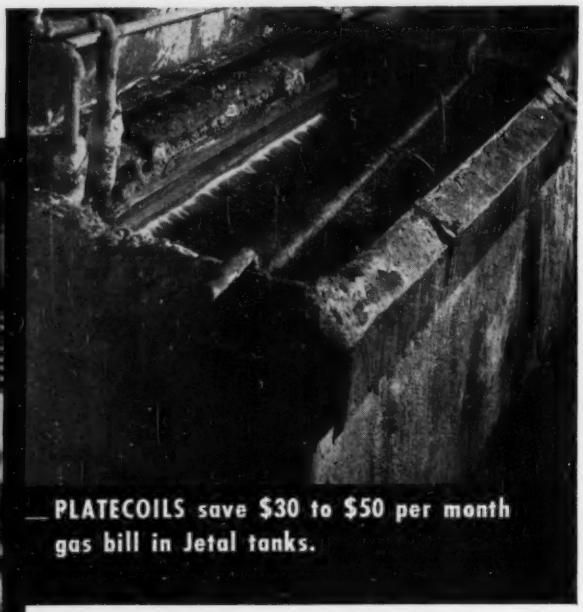
PHILLIPS CHEMICAL COMPANY
A Wholly Owned Subsidiary of Phillips Petroleum Company
Bartlesville, Oklahoma

Phillips 66

*A Trademark

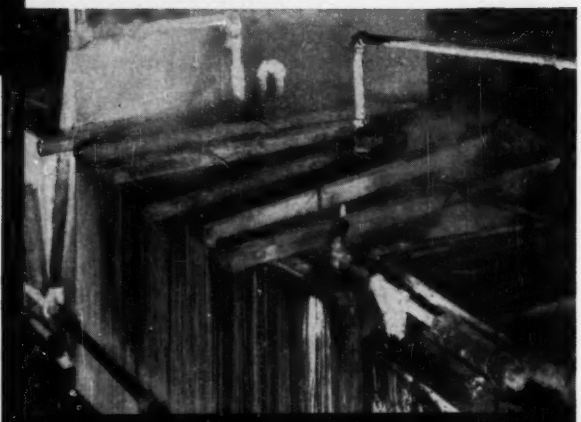
at SESSIONS CLOCK Co.





PLATECOILS save $30 to $50 per month gas bill in Jetal tanks.

PLATECOILS heat alkali tank without downtime.

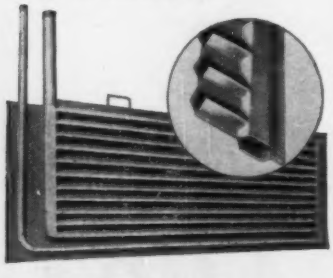


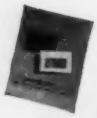
PLATECOILS cure coil-itis

PLATECOILS®

eliminate weekly pipe coil cleaning in lubrite tanks

A Tranter Platecoil installed in July, 1952, has *never* had to be removed for cleaning. Previously, two sets of pipe coils were used. One was cleaned while the other was in the tank. The sets were changed every 4 or 5 days. The complete banishment of unproductive downtime in this instance is matched by other types of savings in other installations. In many cases, Tranter Platecoils have reduced warmup time because they actually do transfer heat faster. They have increased tank payloads because they take less space. They have saved maintenance time and money because they are installed on simple hangers and can be removed and replaced much more quickly than pipe coils on complicated racks or brackets. Put Tranter Platecoil's savings to work for you.





Write today for Bulletin No. P61 See how 12 companies are effecting savings every day by using Platecoils.

Platecoils overcome the limitations and operating difficulties of pipe coils by heating or cooling 50% faster, taking 50% less space and saving up to 50% on initial and maintenance costs.



PLATECOIL Div. TRANTER MANUFACTURING, inc., Lansing 4, Michigan

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

POWELL LUBRICATED PLUG VALVES

FIG. 3059G—300-Pound Steel Flanged End Valve. Sizes 6" to 12".



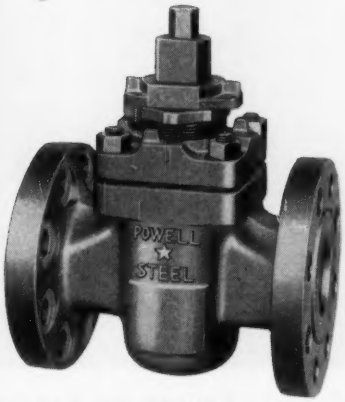


FIG. 1559—150-Pound Steel Flanged End Valve. Sizes 1" to 4".

Powell Valves—the *complete* quality line—offer many outstanding features in these new Lubricated Plug Valves, such as quick and sure operation and a positive seal when the valve is closed.

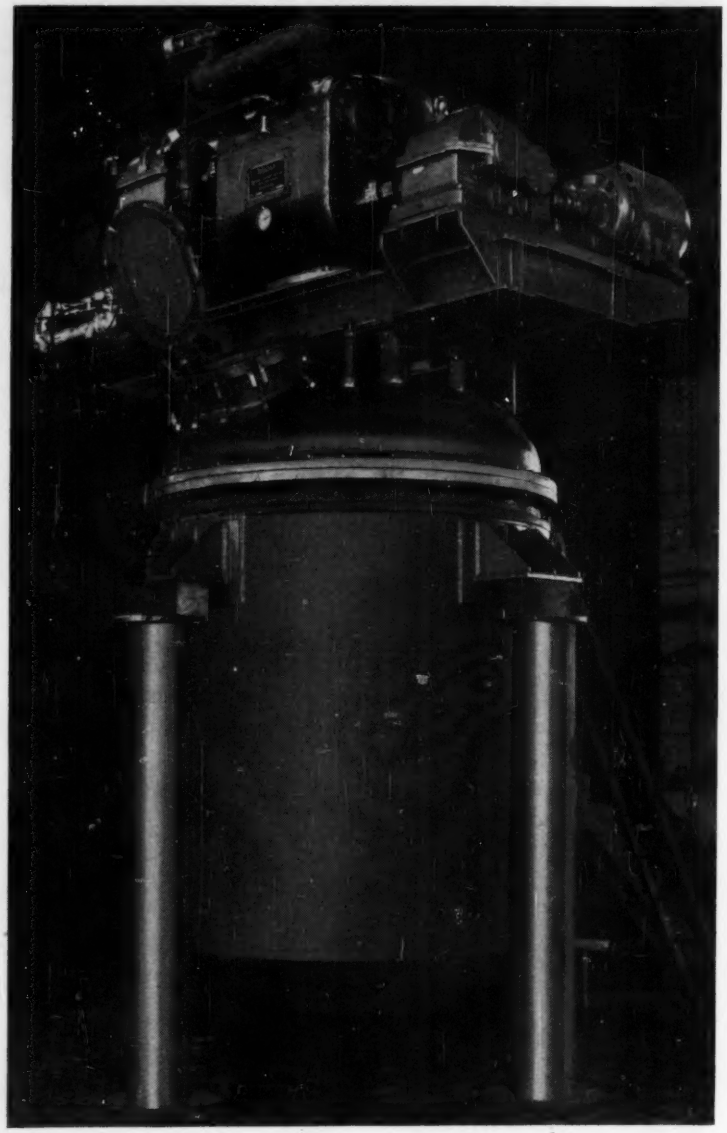
Valves are available with screwed or flanged ends; single, screwed and bolted gland types, and in Semi-Steel, Carbon Steel, Bronze, Ni-Resist, Monel Metal, and Stainless Steel. Semi-Steel valves are rated 175 and 200 pounds W.O.G.; Steel valves, 150 and 300 pounds W.P. Sizes from 1" to 12". Valves in sizes 6" and larger can be furnished with gears for gear operation. Distributors located in principal cities. For descriptive literature—or help on valve problems—write direct to

The Wm. Powell Company, Cincinnati 22, Ohio.....109TH year

Buflovak Jacketed Grease Kettles are engineered for specific process requirements

...to fit specific processing operation needs

...to provide profitable performance



The kettle illustrated is a Buflovak Jacketed Grease Kettle with a 2500-gal. capacity. It is equipped with a compact 150-hp Cone Gear Drive for operating a Double Motion Agitator, with scrapers, to speed operation. A pneumatic discharge valve saves valuable time. It was designed and engineered by Blaw-Knox engineers to meet the specific requirements of the operation for which it was built.

We can help you solve your kettle problems. Blaw-Knox engineers have had a broad experience in designing and building kettles of every description, from the laboratory—few-gallon, capacity models to ones that process several thousand gallons—not just greases but a large number of varied products. This experience enables our engineers to incorporate in the design of each kettle all the features that are particularly applicable to the operation under consideration. Such features include size of kettle, type of body, agitators, drive, high or low temperature control, method of heating and cooling, heat source, openings and outlets, and so on.

Why not call us and let Blaw-Knox engineers make their recommendations?

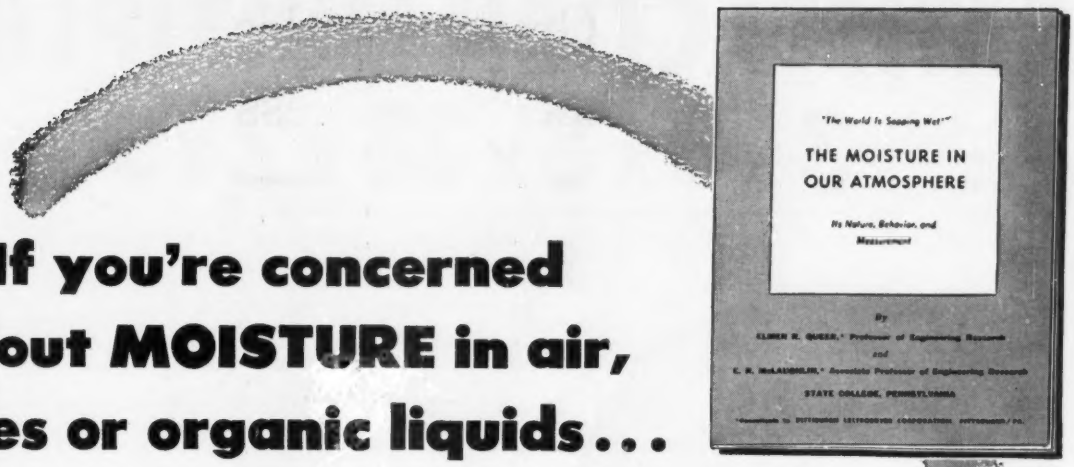
A Complete Process Equipment Service

Kettles of every description constitute but one phase of Blaw-Knox Process Equipment design, engineering and fabrication service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries: EVAPORATION • DRYING • FLAKING • MIXING • REACTION IMPREGNATING • VULCANIZING • SOLVENT RECOVERY SOLVENT EXTRACTION • CRYSTALLIZATION • DISTILLATION POLYMERIZATION • GAS CLEANING • GAS ABSORPTION • HEAT TRANSFER • VAPORIZATION • CONDENSATION • STERILIZING LOW AND HIGH PRESSURE PROCESSING

CATALOG NO. 356-R is available on request

Everything in Process Equipment

BLAW-KNOX COMPANY
BUFLOVAK EQUIPMENT DIVISION
1551 Fillmore Avenue, Buffalo 11, N. Y.



If you're concerned about MOISTURE in air, gases or organic liquids...

SEND FOR THIS LITERATURE

Moisture you can't see or feel causes endless trouble. It creeps into materials and hinders their free flow, gums up machines and slows operations to a standstill. It upsets delicate chemical reactions, spoils products in process and storage. A Lectrodryer* booklet discusses *The Moisture in Our Atmosphere.*

The roadblocks you can set up against infiltration of moisture, the means you can employ to remove unwanted moisture and hold it down to desirable low limits—other Lectrodryer literature covers these subjects.

Lectrodryers are a complete family of machines for DRYing air, gases or organic liquids to low dewpoints. Whatever your specialty, you should have Lectrodryer data in your files for reference when moisture becomes a problem. This coupon will bring it to you.



LECTRODRYER

*REGISTERED TRADE MARK U. S. PAT. OFF.

Pittsburgh Lectrodryer Corporation
303 32nd Street, Pittsburgh 30, Pennsylvania

Send me DRYing data.

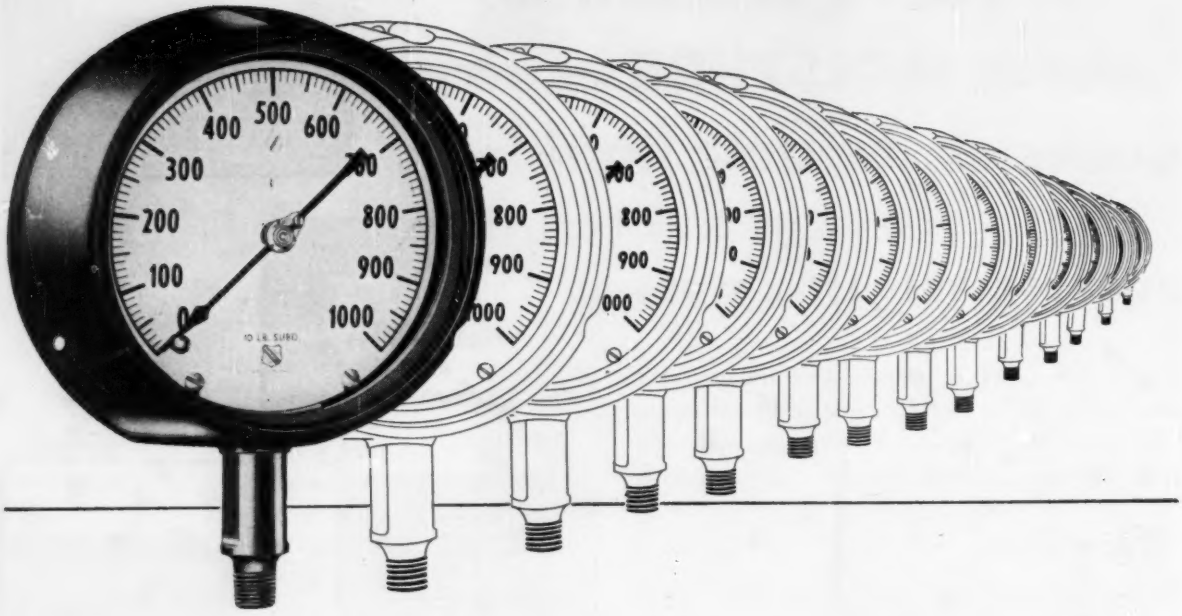
Name_____ Title_____

Company_____

Address_____

_____

SATISFACTION MULTIPLIED
3x8x8x38x2x5



Service Conditions primarily determine the pressure gauge you specify for your installation. The wrong gauge can cost time, trouble, and money.

That's the big reason why Ashcroft Duragauges make sure of your complete satisfaction by offering a multiple choice in case designs and materials, Bourdon tube materials, ranges, movements, and dial sizes. Briefly, you can select the right gauge for your requirements from:

Cases of 3 different materials in 8 service-proved designs.

Bourdon Tubes of 8 different types of metals to meet specific service requirements.

Pressure Ranges from 30" vacuum or a few ounces through 100,000 psi.

Rotary Geared Movements that include the famous "Nylon Movement" or all stainless steel.

Dial Sizes from 4½" through 12".

Most important, Ashcroft Duragauges provide that unbeatable combination of highest sustained accuracy and durability of any pressure gauge built.

TAKE ADVANTAGE of the counsel of your nearby Industrial Supply Distributor. You can count on him to help you select Ashcroft Duragauges that will serve better and longer, with minimum maintenance, no matter how severe the conditions of vibration, pulsation, corrosion and weather.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



HOW DO YOU BENEFIT WITH KARBATE BRAND IMPERVIOUS GRAPHITE PROCESS EQUIPMENT?

ANSWER:

By using "Karbate" products, you can:

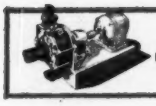
- **Eliminate corrosion, metallic contamination and the effects of thermal shock**
- **Utilize proved, rugged designs for long life, low maintenance**
- **Order standard stock items for lower cost, faster delivery**
- **Rely on service and application recommendations from National Carbon's technical staff**

Many features recommend "Karbate" chemical process equipment for a prominent place in your plant. Its low first-cost, long service life and freedom from mechanical troubles merit your *first* consideration — not only in those highly corrosive services where nothing else will do, but *wherever* corrosion is a factor.

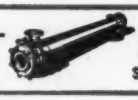
Write for literature!

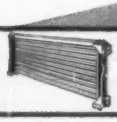
The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco
IN CANADA: Union Carbide Canada Limited, Toronto


Pumps—Catalog Section S-7250


Pipe and Fittings—Catalog Section S-7000


Heat Exchangers—Catalog Sections S-6740 and S-6840


Cascade Coolers—Catalog Section S-6820


HCl Absorbers—Catalog Section S-7460

PROVEN by 8 years

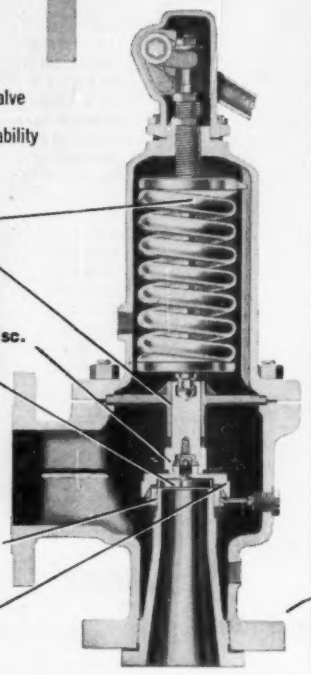
THOUSANDS of Successful Installations of Farris "4 in 1" Safety Relief Valves*

NOTICE: Farris Safety Relief Valves, the Internal Heat Exchanger, and Bellows construction are covered by U.S. Patents and Patents Pending. Copyrights, where applicable, are registered.

1 STANDARD FULL NOZZLE SAFETY RELIEF VALVES

Here is the ultimate in nozzle valve construction with complete standardization and interchangeability in every part:

- **Round wire springs calibrated for rating.**
- **2½ to 1 guiding ratio, close tolerances.**
- **Alignment spool for perfect alignment and bearing from stem to disc.**
- **Self-aligning, optically-flat replaceable disc of forged Stainless Steel.**
- **All bearings of hardened Stainless Steel.**
- **Expanded orifices increase capacity.**
- **Single blowdown ring does not affect capacity—simple adjustment.**
- **Flared disc-holder for ultimate operating efficiency.**



BALANSEAL© SAFETY RELIEF VALVES

BalanSeal construction isolates all working parts. It consists of a neutral area bellows equalling the area of the seating surface, incorporating a mechanically-held seal for the lower part to greatly enhance replacement. BalanSeal can be simply installed any time. Because BalanSeal neutralizes effects of back pressures, resulting in a constant, safe relieving point on the upstream side, size of back pressure piping can be drastically reduced—for pipe savings up to 15 times the cost of the valve! Where accurate set points must be depended upon, BalanSeal stands alone.

For eight years Farris has been setting-the-pace-in-safety with "4-in-1" Safety Relief Valves, the "standard" for long service life, minimum maintenance and positive protection.

Farris' recognition as the pace-setter of the industry is no accident, but the result of many engineering "firsts" in improved valve design—FIRST with balanced bellows construction . . . FIRST to offer multiple nozzle sizes within one valve . . . FIRST with a line of bar stock safety-relief valves for pressures to 10,000 lbs. . . . FIRST to offer internal heat exchangers . . . FIRST to offer realistic pricing, giving the customer the benefit of manufacturing economies . . . and only Farris can point to proved-in-service performance . . . because Farris is the pioneer manufacturer of safety relief valves with bellows.

FOR ENGINEERS: Catalog 48Ra on the full line of Farris Safety Relief Valves; and Technical Manual 51B—"Principles of Manifold Discharge Piping". Available on request.

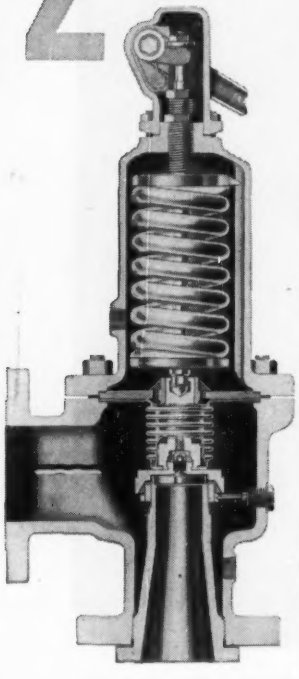
"THE FOX AND THE HARE"



Send for this popular entertaining pamphlet presenting a story about the recognition of BALANSEAL valves. It is humorous and enlightening. Just ask for it by name.

of ACTUAL SERVICE

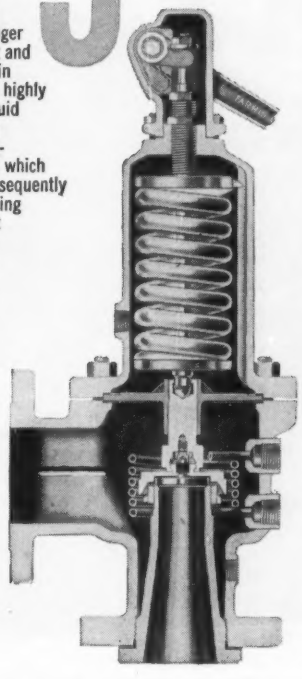
2



INTERNAL HEAT EXCHANGER

The exclusive Farris Internal Heat Exchanger eliminates inefficient and costly steam tracing in a valve body to keep highly viscous media in a fluid state. It consists of a stainless steel coil inserted in the body to which steam is fed and subsequently trapped out. For placing heat where it is most effective, increasing efficiency, lowering steam consumption, the Farris Internal Heat Exchanger is the only available product of its kind.

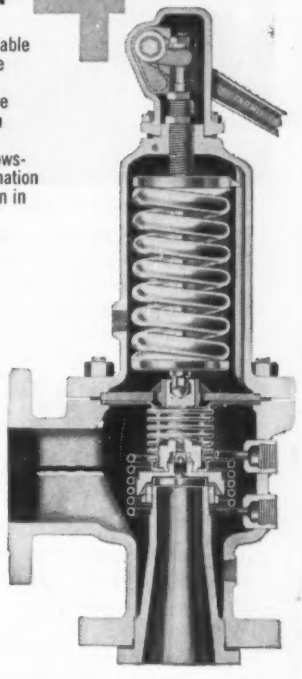
3



BELLOWS—HEAT EXCHANGER COMBINATION

For completely dependable valve operation in spite of sticky fluids (tars, asphalt, etc.) and where complete freedom from contamination is required, select the Bellows-Heat Exchanger combination . . . The ultimate design in safety relief valves for applications where material is highly viscous. All parts are Farris Standard construction.

4



*** CERTIFIED AND APPROVED by the National Board of Boiler and Pressure Vessel Inspectors, complying with ASME requirements. Tests made at university laboratories by independent observers. Certification data available on request.**

and Still the Lowest Prices in the industry!

Coming Soon!

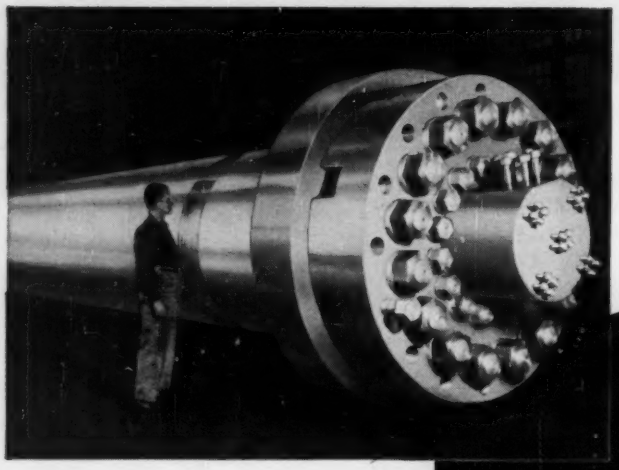
An added line of ultimate capacity nozzle valves

Farris **ENGINEERING CORPORATION**

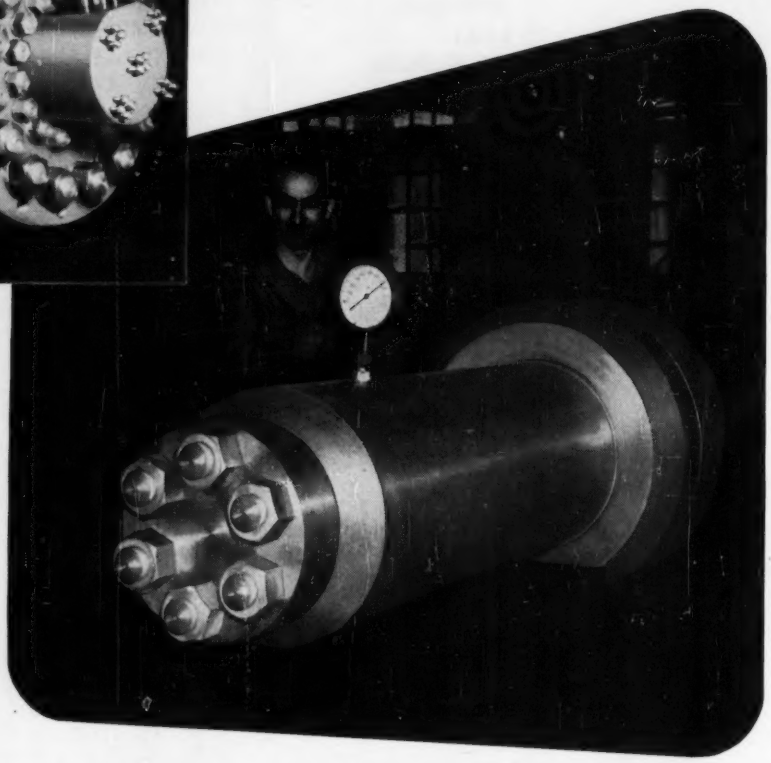
405 COMMERCIAL AVENUE, PALISADES PARK, NEW JERSEY

Affiliates: Farris Flexible Valve Corp. • Farris Stăcon Corp. • Farris HydroTorque Corp. Farris HydroSeal Corp. • Farris Pickering Governor Co.

WHAT'S YOUR PRESSURE PROBLEM?



4,000 PSI CONVERTER



40,000 PSI CYLINDER

MIDVALE FORGES VESSELS TO YOUR SPECIFICATIONS

These pressure vessels are just two examples of the wide adaptability of Midvale facilities to forge and machine pressure vessels to your specifications. One was a big brute of chrome-vanadium steel with an overall length of 468′, inside diameter of 45″ and outside diameter of 61½″ . . . with a working pressure of 4,500 PSI. The other only 102″ in length, inside diameter of 10″ and outside diameter of 22″ . . . but was tested to 40,000 PSI.

Both varied greatly in the equipment necessary and the production procedure used, but the same engineering and forging experience—gained over more than half a century—solved the problem of each. The quality of both was carefully guarded from the time the ingot was poured until final machining. Physical testing and careful inspection assured pressure vessels to give long service in the installation specified.

Next time your plans include vessels for the production of chemicals, petroleum, rubber or other products call on Midvale engineers. Their experience with forged vessels will help you from the initial design to the final installation.

THE MIDVALE COMPANY-Nicetown, Philadelphia 40, Pa.

Offices: New York, Chicago, Pittsburgh, Washington, Cleveland, San Francisco

MIDVALE

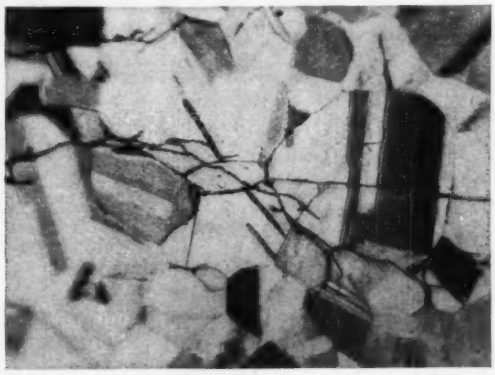
FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Photomicrograph of stress-corrosion cracks in Admiralty tube. (Mag. 500 times).

Stress Corrosion Cracking Shortens Tube Life Needlessly

Properly selected condenser tubes subject to normal corrosion will generally give long, economical service. Tubes subject to corrosion plus stress will sometimes fail prematurely. Analyzing the causes of stress corrosion shows this type of tube failure can often be prevented.

Causes of Fatigue and Corrosion Fatigue Cracking

Perhaps the most common cause of condenser-tube stress is vibration. A pulsating vapor or fluid entering at high velocity can set tubes vibrating at their resonant frequency. Nearby rotating machinery such as turbines, pumps, fans, motors, etc., can have the same effect. Repeated vibratory flexing strains, if prolonged and severe enough, will result in the formation of transcrystalline cracks eventually extending through the tube wall. The protective film of normal corrosion products is broken, and the corrosive medium seeps into the cracks, further weakening the tube metal by its attack.

Areas of greatest stress from vibration occur close to the tube supports, where the sharpest bending takes place. Here, and less frequently midway between supports, from a few to a hundred tiny transverse cracks will form in the tube wall. Just one crack can eventually cause failure.

If the tubes are closely spaced, vibration may bring them into contact with each other, abrading their outer surfaces. Tube vibration can take place without being noticeable outside the exchanger shell. Its only indication may be abrasion marks on tubes found during routine inspection, or tube failure itself, suffered during operation.

Vibration can be damped by wedging strips of wood or flattened tube pieces between the affected rows of tubes. Additional tube supports is another, more expensive though more satisfactory answer. If nearby machinery is causing the vibration and it is feasible to do so, the critical speeds can be avoided, thus eliminating the vibration.

Stress Corrosion or Season Cracking

Another common cause to tube stress that can lead to stress corrosion cracking is over-rolling tubes into tube sheets. A little extra care in tube rolling may prevent this happening. Sometimes another more resistant tube alloy or frequent cleaning of the tubes is needed. Stress can also be set up in tubes by such factors as high operating pressures, restrained thermal expansion and contraction, or by bending, flattening or denting tubes by rough handling. Good design and, again, reasonable care are the answers. Residual stress in tubes as supplied by the manufacturer is seldom significant, thanks to modern annealing practices.

That stress of any cause may contribute heavily to tube failure has been graphically proved in the Bridgeport Corrosion Laboratory, where constant research is at work for you. Tests show that, in the absence of stress, no cracking has occurred. On the other hand, stress did promote cracking in certain solutions or vapor, notably ammonia or mercury.

Causes of Corrosion

The most destructive corrosion in stress cracks is caused by traces of ammonia and mercury. Ammonia is usually generated through decomposition of organic matter during shutdown or low-velocity operation. Mercury sometimes enters the system as mercury salts, present in certain crude oils, or as free mercury from measuring or control devices. The combined action of oxygen and moisture and ammonia is needed to produce stress-corrosion cracks.

The best way to keep ammonia from forming is to keep exchangers clean and dry during shutdowns or to use chlorination during operation to prevent slime accumulation. Be careful of chlorination, though. In concentrated amounts, it severely attacks copper and copper alloys.

The Role of Alloys

In general, when stress is likely to occur unavoidably in the presence of ammonia and mercury, the proper choice of alloy is the most effective solution. Copper is the most resistant metal to stress-corrosion cracking, followed closely by 70/30 Cupro Nickel, and then by Red Brass, Aluminum Bronze, (Duronze IV), Admiralty, Muntz and Aluminum Brass.

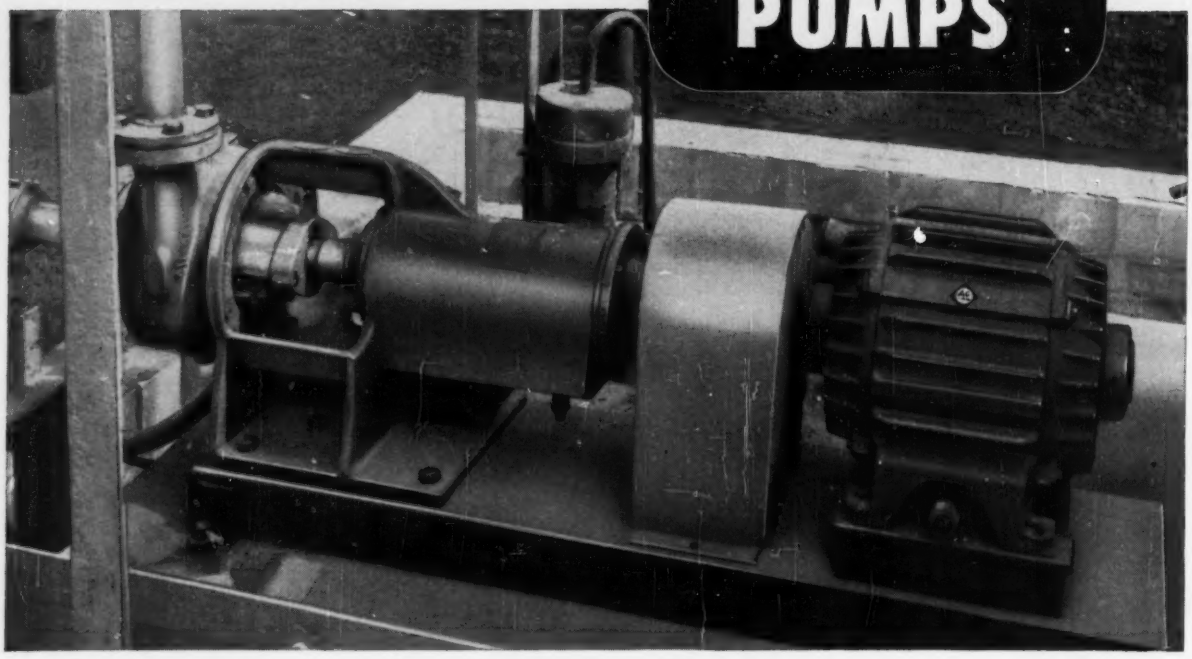
If stress corrosion cracking is costing you money and loss of production, ask Bridgeport Technical Service to analyze the factors involved and recommend the alloy best suited to your operating conditions. We have successfully solved many such problems in a wide variety of applications. Call your nearest Bridgeport Sales Office for a copy of the Bridgeport Condenser Tube Handbook. This 165-page volume has a wealth of valuable information for users of condenser tubes. (2155)

Save Hundreds of Dollars

on Many Process Pump Applications

ALLIS-CHALMERS

CHEMICAL PUMPS



This pump will do many of the jobs of a costly refinery-type pump, yet it costs hundreds of dollars less to buy.

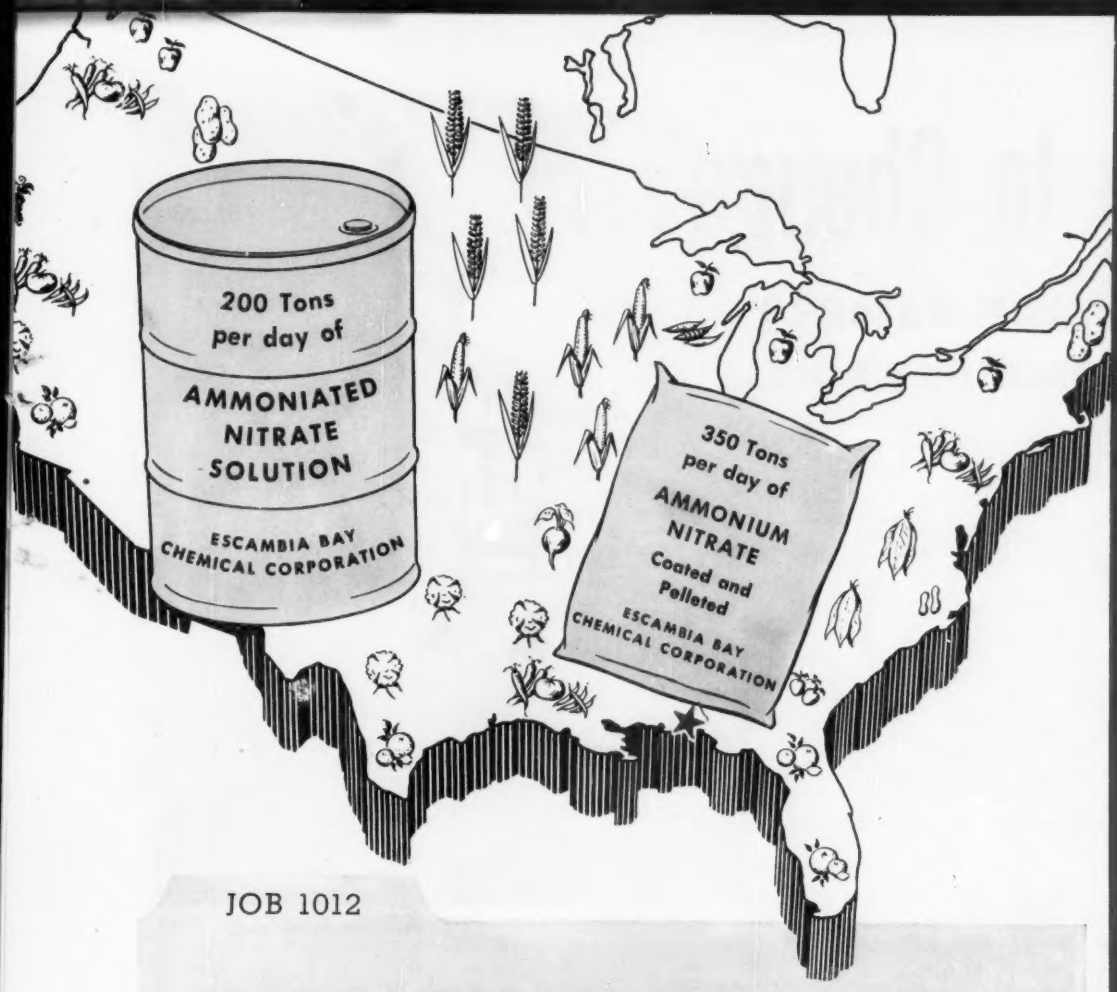
It isn't meant to do every job in the chemical industry. But it will handle a big percentage of the jobs. Check the construction and design features that make this possible:

- It's built in most used ratings . . . to 3500 gpm, heads up to 550 ft.
- Handles liquids in most common temperature range . . . up to 550 F.
- Pumps liquors, corrosive materials and solutions, and petroleum products.
- Built in wide choice of materials including: iron, bronze, aluminum bronze, stainless steel, high nickel alloys and others.
- Available with several sealing methods including standard packing, inside and outside mechanical seals, plus special features such as cooling water jacket, smothering gland and others.
- Features double-row, oil-lubricated bearings. Two oil rings running in generous reservoir of oil carry oil to bearings.
- Rigid cast-iron frame supports pump body and holds bearings in alignment.

Get complete information. Call your nearby Allis-Chalmers district office. Or write to Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for Bulletin 52B7638.

A-4527

ALLIS-CHALMERS



JOB 1012

A Complete Integrated Fertilizer Plant

designed and now being constructed by CHEMICO for Escambia Bay Chemical Corporation at Pensacola, Florida ★ to help America produce better crops

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

Designers and constructors of complete plants and facilities for the chemical, metallurgical and petrochemical processing industries for over 40 years

525 WEST 43RD STREET, NEW YORK 36, NEW YORK

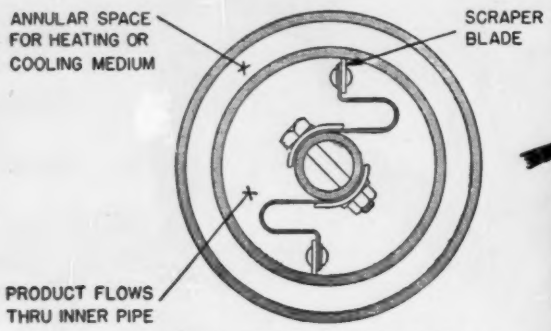
Cable Address: Chemiconst, New York • Technical Representatives: Cyanamid Products Ltd, London South African Cyanamid (Pty) Ltd., Johannesburg

CHEMICO

CHEMICO CHEMICAL CONSTRUCTION CORPORATION

Time to Change...

...FROM BATCH TO CONTINUOUS PROCESS



Section thru Double Pipe Exchanger





Scraped Surface Exchanger Unit under test in our shop

Unsurpassed for Top Performance in Processing characterized by:

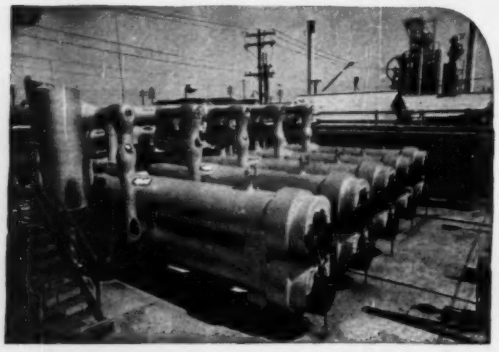
1. Heat transfer with crystallization
2. Heat transfer with severe fouling of surfaces
3. Heat transfer with solvent extraction
4. Heat transfer with continuous mixing and conveying
5. Heat transfer with high viscosity

Chemical processors in search of equipment with which to modernize operations are invited to consider the possibilities of Vogt *flow-thru* Scraped Surface Exchangers in such service. The wide range of uses to which they have been adapted indicates their definite value in the chemical processing fields.

Vogt Scraped Surface Exchangers are closed, *flow-thru,* pressure type systems which permit the use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Usually fabricated from ferrous material, their simple construction permits the ready use of special materials such as pure nickel or stainless steel to meet special requirements.

General information is in Bulletin PE-1, write for it.

An outdoor installation of Scraped Surface Exchangers

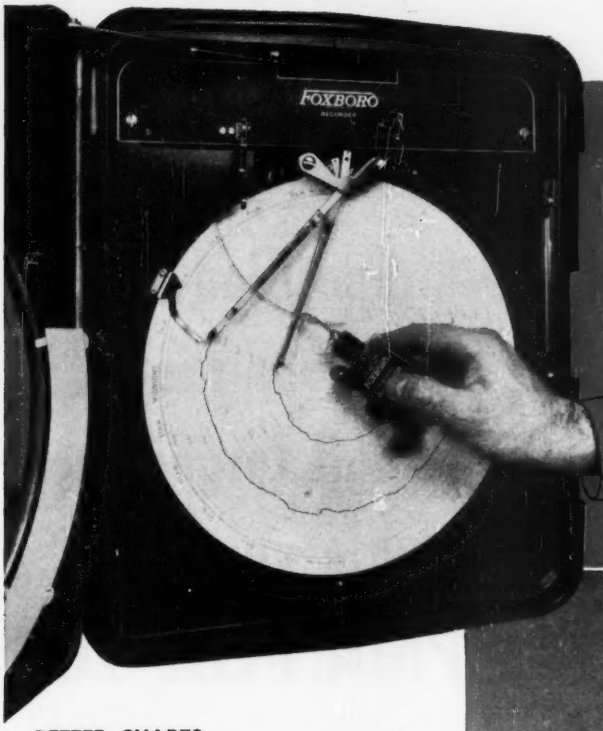


Vogt *flow-thru*

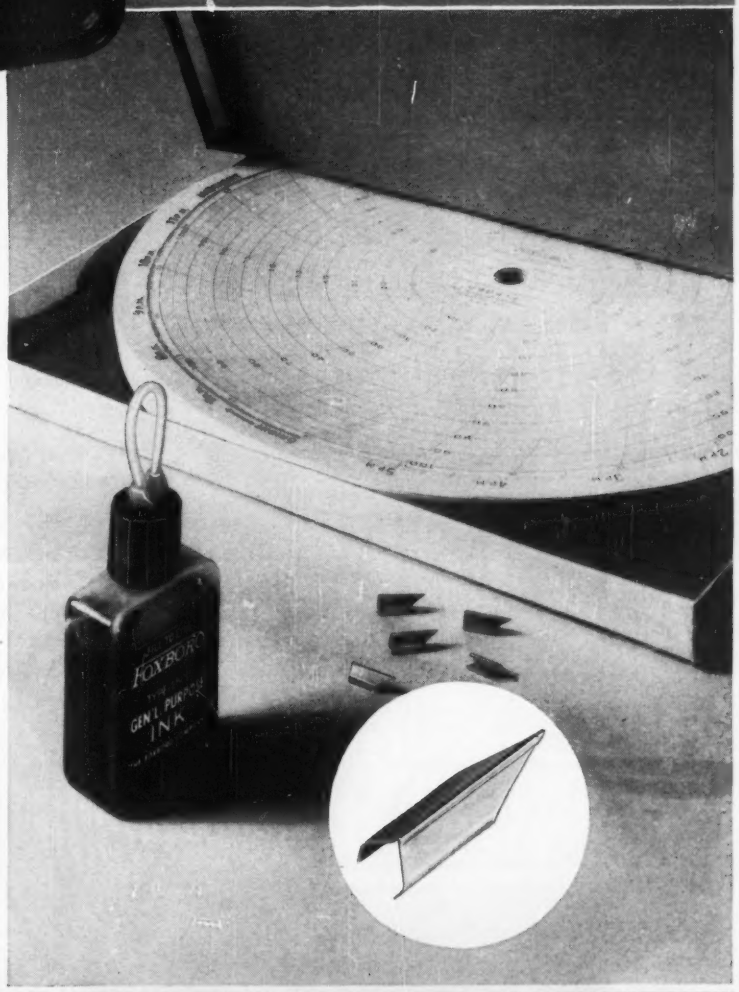
Scraped Surface EXCHANGERS

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Cleveland
St. Louis, Dallas, Charleston, W. Va.



Better Records



BETTER CHARTS

Humitex Charts printed from high-precision plates, under controlled humidity conditions, on special, high-stability paper. Easy-to-read gray printing against chart's smooth, white background brings out full brilliance of new Foxboro Ink.

BETTER PENS

Non-corroding, stainless-steel pens with positive capillary feed. Controlled special-process points (standard and fine line) assure sharper, cleaner records.

BETTER INK

Five rich, brilliant colors . . . won't clog or "feather" . . . sediment-free . . . flows smoothly under all atmospheric conditions. Specially formulated for new Foxboro Pens and Charts.

NEW INK DISPENSER

Exclusive-design, easy-to-handle polyethylene "squeeze" dispenser (pat. pend.) gives pin-point control of drop size, ends messy pen-filling. Won't leak or break.

THE FOXBORO COMPANY
367 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO REG. U. S. PAT. OFF. **FOR BETTER RECORDS**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



Specified for More Jobs than any other small forged steel gate valve

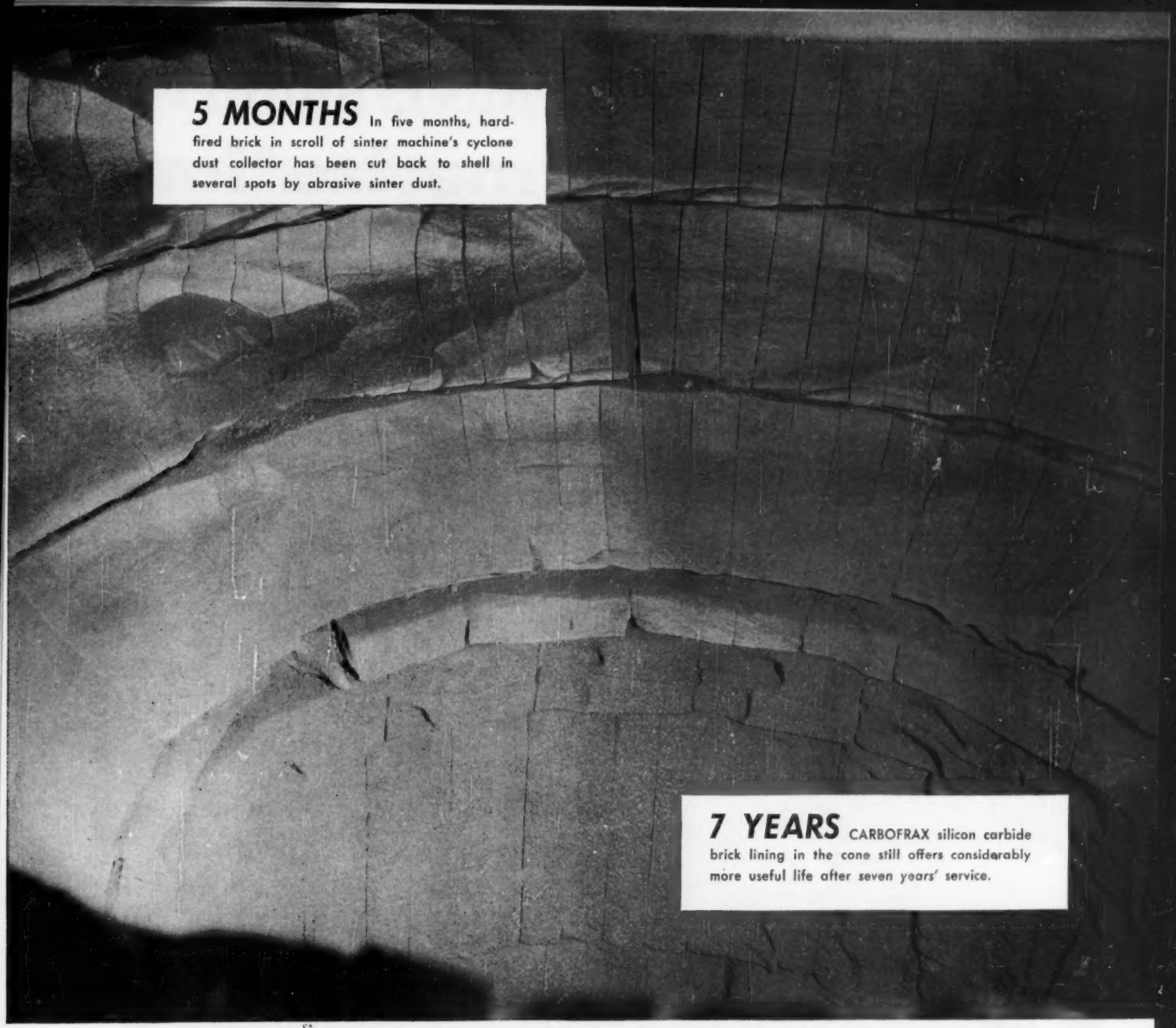
CHAPMAN List 960

Chapman List 960 is specified for more different applications than any other small forged steel gate valve in the world. Engineers know that List 960 valves keep maintenance expenses low under the most severe service conditions.

Seizing and galling are virtually eliminated, because wedge gate faces are superhardened to 800 Brinell. Stainless steel seat rings, hardened to minimize wear, are easy to replace, make it unnecessary to lap-in gate and seats. Stem guide passages are carefully machined to minimize stresses, keep operation smooth and trouble-free over long periods. Stem-and-gate connection is extra strong where extreme stresses can develop.

For every application you have for small forged steel gate valves, specify Chapman List 960. Sizes from ¼″ to 2″. Rising stem with yoke (shown) or rising stem with inside screw. Metal-to-metal or gasketed bonnet joint, depending on application. Pressure range to 2000 pounds at 100°F, to 380 pounds at 1000°F. For higher pressures, specify List 990. Write for your copy of Catalog 10 now.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS



When other lining materials wear away too fast . . .

IT'S TIME YOU CHECKED UP ON THE ABRASION RESISTANCE OF CARBOFRAX® BRICK

Today, plant operators have a new use for CARBOFRAX silicon carbide refractories . . . *lining dust collectors, downcomers, coke chutes and similar equipment exposed to severe wear and abrasion.*

Silicon carbide, the principal component of CARBOFRAX linings, is one of the hardest materials known to man. It is so hard that even high-velocity gases laden with sharp particles fail to leave their mark.

To keep initial costs down, CARBOFRAX brick and shapes are used only in the areas where abrasion is most severe. They last longer and help the surrounding brickwork to last longer, too. So even though CARBOFRAX refractories are more expensive than some other lining materials, they are proving more practical . . . *and more economical to use.*

An inexpensive way to see for yourself what a silicon carbide lining can do is to install a few courses of CARBOFRAX brick at the area of worst erosion and check on their condition as time passes. You'll soon want to investigate further! For detailed information write Refractories Division, The Carborundum Company, Perth Amboy, N. J., Dept. H75.

Nothing resists abrasion like an abrasive!

CARBORUNDUM

Registered Trade Mark

How A. O. Smith Texas polymerization REACTORS, HEAT METALLURGICAL VESSELS



THIS installation shows that A. O. Smith service extends far beyond the usual supplying of vessels and exchangers to order. Here, our metallurgical research served to prescribe the chemical specifications used by the customer to improve the corrosion-resistance of specific reactor linings.

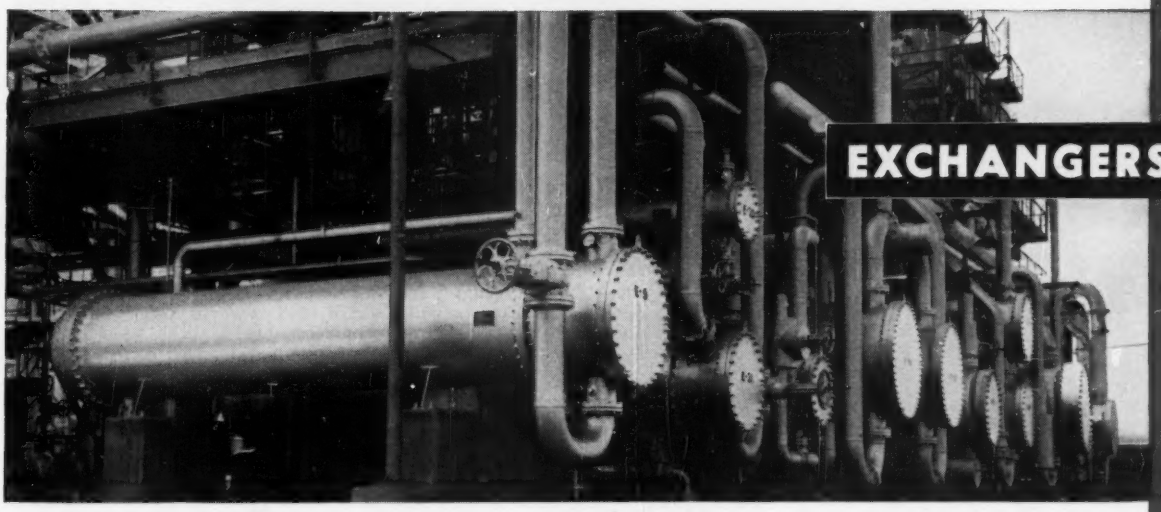
A. O. Smith supplied special pressure vessels, as well as five different kinds of heat exchangers for the phosphoric acid polymerization unit.

This typical example shows why the petroleum, petro-chemical and chemical industries bring their pressure vessel and heat exchanger problems to A. O. Smith.

Investigate A. O. Smith's performance in terms of your own processing needs. Write our nearest office. We'll be glad to give you detailed information about A. O. Smith pressure vessels and heat exchangers, engineering and research.

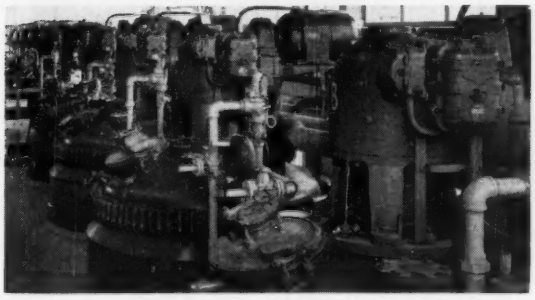
serves refineries

unit uses EXCHANGERS AND RESEARCH



Three A. O. Smith reactors with type 316 ELC lining are the heart of the unit. Designed for operating pressures of 640 psi, the vessels have 102-in. ID . . . are 58 ft. long with 2⅜ in. wall thickness.

The unit has 21 A. O. Smith heat exchangers. These include reboilers, condensers, coolers, heaters and exchangers, ranging in diameter from 15 to 51 in. We make all types of heat exchangers required by a petroleum refinery.



Broader service through Glascote — For more than 20 years, our subsidiary, Glascote Products, Inc., Cleveland, has been serving the process industries. Glascote can supply you with corrosion-resistant laboratory and pilot plant reactors . . . single-shell or jacketed storage tanks . . . double-jacketed condensers . . . columns.

Through research A.O. Smith *. . . a better way*

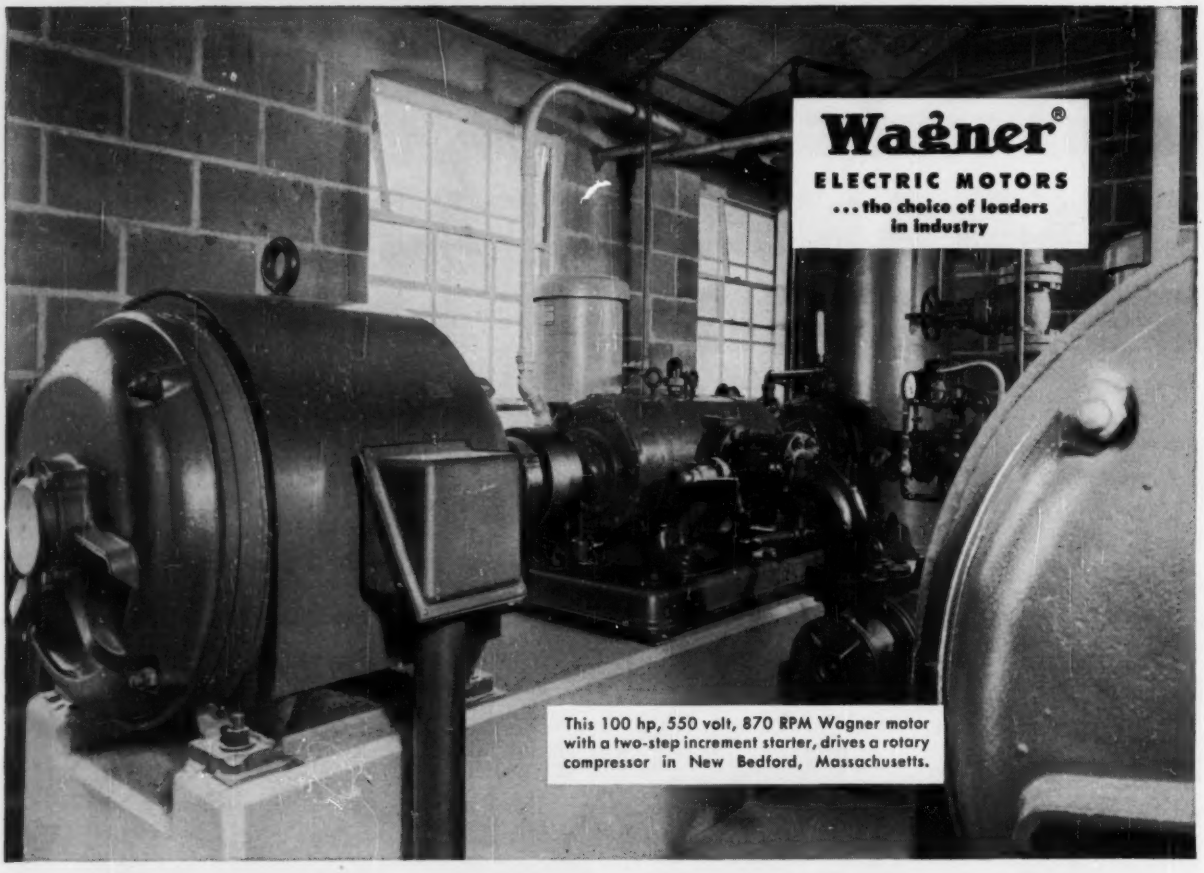
A.O.Smith

CORPORATION

MILWAUKEE • HOUSTON • LOS ANGELES

Glascote Products, Inc., Cleveland, Ohio

International Division: Milwaukee 1



This 100 hp, 550 volt, 870 RPM Wagner motor with a two-step increment starter, drives a rotary compressor in New Bedford, Massachusetts.

Start large polyphase motors with minimum line voltage disturbance

USE THE Wagner INCREMENT MOTOR AND STARTER COMBINATION

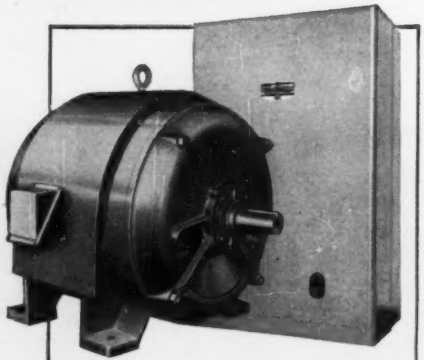
Here's a modern, economical, highly efficient way to start large polyphase motors – the Wagner Increment Motor and Starter "Package."

By reducing current drawn from the line on each point of the starter, the combination limits the inrush of motor current to values that are acceptable for the distribution systems of most power companies.

Voltage disturbances on the line are reduced because current taken from the line is not broken during the starting period–as it is when auto-transformers or compensator type starters are used.

Wagner two-step increment motor and starter combinations are suitable for most applications. For installations where unusually low inrush of starting current is desired, Wagner can furnish three-step and four-step increment starters.

Your nearby Wagner engineer will help you select the increment motor and starter combination that meets *your* requirement. Call the nearest of our 32 branch offices, or write us.



Type RP polyphase motor in ratings to 400 hp with increment type starter



Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

M55-16

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS–AIR AND HYDRAULIC

No other drive does all these jobs like

Link-Belt SILENT CHAIN

YES, if you need a drive like any one of these six, you're money ahead with SILENT CHAIN

COMBINING the flexibility and quietness of a belt with the positive action and durability of a gear — Link-Belt Silent Chain offers unmatched advantages for a wide range of drives. Check these reasons why:

- Lower cost—often lower in first cost, always lower in ultimate cost.
- Longer life — trouble-free performance for 25 or 30 years is common.
- No dismantling machine or removing sheaves for repairs.
- Better than 98% efficiency.
- Maintained ratio assures full productive capacity.
- Slipless action assures a better product.
- Easy to install.
- Safe to employees — operates in oil-retaining casing.



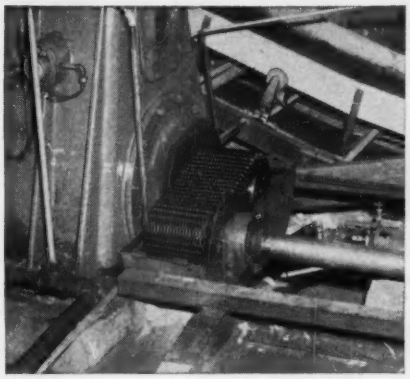
New 88-page Book 2425 gives complete data on silent chain. Ask a Link-Belt engineer or distributor for your copy today.

LINK-BELT

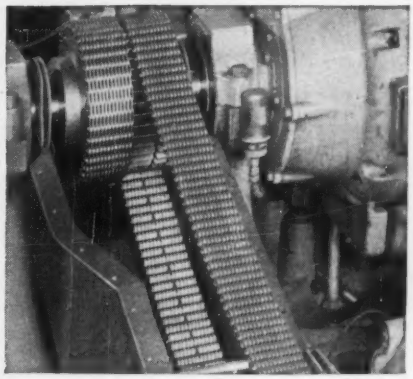
13,802

SILVERSTREAK
SILENT CHAIN DRIVES

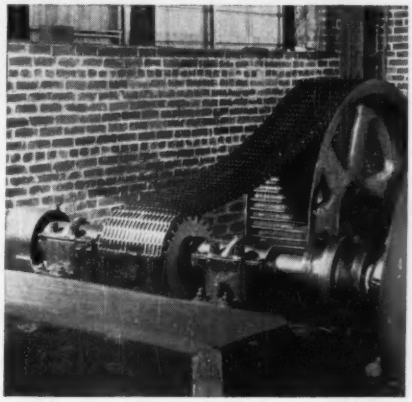
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



1 **Production increased 33%** when speed of this peeler lathe was stepped up by installing two silent chain drives. Neither engine nor lathe had to be moved.



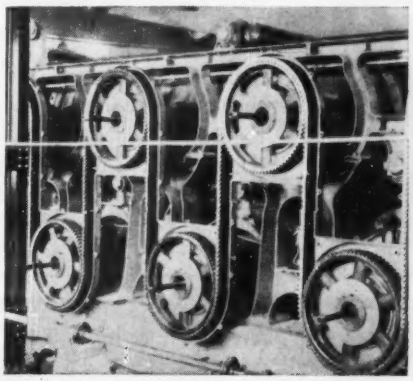
2 **Constant, high speeds** were assured by equipping each of 48 automotive test stands with two Link-Belt Silverstreak Silent Chain Drives.



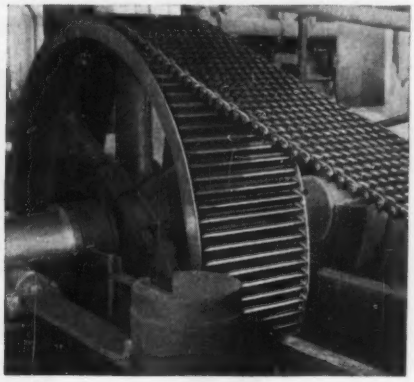
3 **Long life under severe service**—This 250-hp Link-Belt Silent Chain Drive has operated line shaft in cold draw section of seamless tube company since 1916.



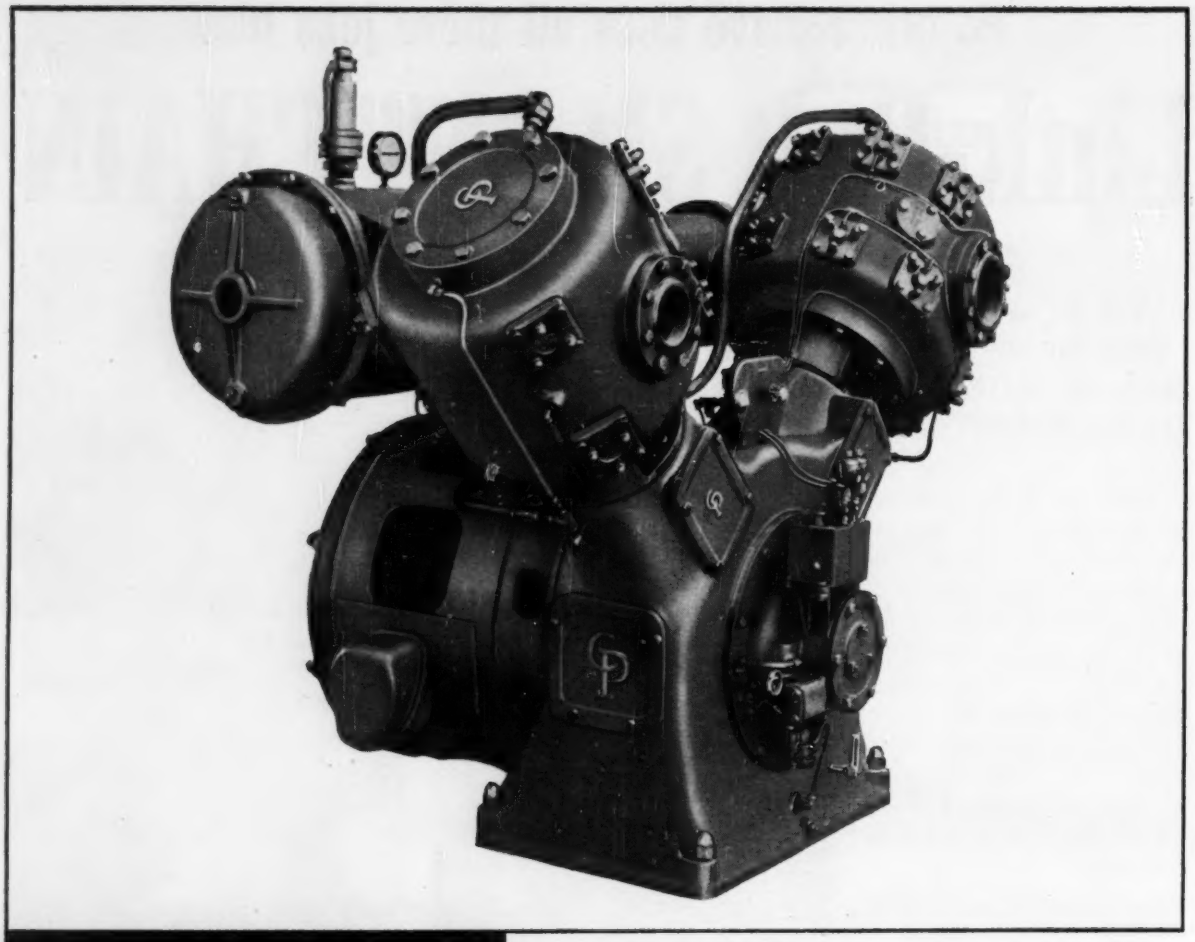
4 **Fractional hp drives** are positive and dependable with Link-Belt Silent Chain. Above, two 3/16" pitch chains drive machine fabricating refrigerator parts.



5 **Accurate timing** is guaranteed for this dryer by Link-Belt Duplex Silent Chain. All shafts travel at uniform angular velocity, permitting precise coordination of process.



6 **Minimum maintenance**—This is one of 24 Link-Belt Silent Chain beater drives in a pulp mill. All have operated for many years with little attention.



for the most in a Compressor

IN THE LEAST SPACE

The Class "Y" compressor offers everything a good compressor should have for heavy duty service: high overall efficiency, long life with minimum maintenance; smooth, quiet operation, accessibility and simplicity, compactness and ease of installation. With one-piece frame, it is shipped intact, including a flange-mounted motor—truly a "package" type unit. Built in sizes 75 to 250 H.P., it is available in single and multi-stage designs for pressures up to 5000 pounds, with belted, coupled or flange-mounted motor drive.

Simplate Valves, efficient and easy-to-clean shell-and-tube intercooler, multistep capacity regulation, roller main and precision type connecting rod bearings are some of the reasons for the big compressor performance of these medium size machines.

Write for Bulletin 766

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

S/Kapades in industry

Buck, the Boss Boiler Expert, had red hair and a vivid green complexion. The complexion came from biliousness—caused by disappearing tube bundles in acid-oil and liquid-sludge heaters.

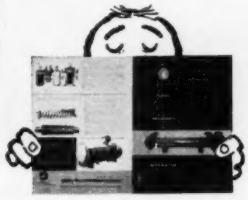
"Wurrrp!" said Buck to his Assistant. "Another tube bundle chawed up by corrosion. We work night and day installing new tubes, sheets and baffles—and they disappear like pie at a picnic."

"And management keeps squawking about heater downtime," said the Assistant. "*And* overtime. *And* retubing costs. Boy, is your face green!"

"Beeeep!" said Buck. "Yours will be red if we don't find a way to lick this corrosion problem."

"I think there *is* a way," soothed the Assistant. "Let's go look at a catalog I just got from Schutte and Koerting."

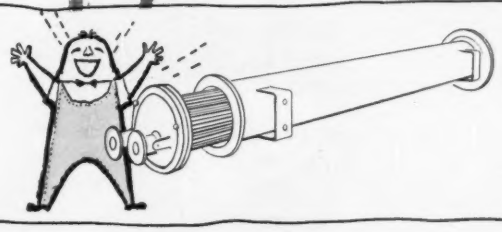
THE CASE OF THE DISAPPEARING TUBE BUNDLES AND THE BILIOUS BOILER EXPERT



Schutte and Koerting Bulletin HT-1, "SK Heat Transfer Apparatus," told Buck just where he could get information about various types of tube bundles. Special materials, sizes, types and modifications—all were covered. "Let's suggest that management call an SK Sales Engineer," said Buck.



The SK Sales Engineer arrived on the double. He took a good look at the corroded tube bundle, asked some pointed questions about materials to be handled, and made some recommendations that caused even the Big Brass to applaud.



CORROSION CONQUERED—BILIOUSNESS BEATEN.

At the SK Engineer's suggestion, new tube bundles of Copper-Silicon Alloy replaced the old bundles in liquid sludge heaters. Result: long, trouble-free operation in processing highly corrosive stock—far less downtime and lower retubing costs—a brand new complexion, not even tinged with green, for Buck, the Boss Boiler Expert!

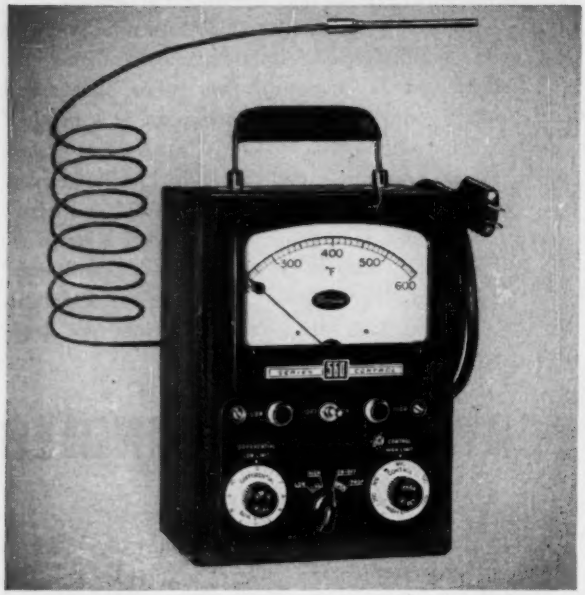
MORAL: *Send today for your free copy of SK Bulletin HT-1 on Heat Transfer Apparatus. And for skilled help with a specific problem, call in a specialist—your nearest SK Sales Engineer.*

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS

2217 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

Jet Apparatus • Heat Transfer Equipment
Strainers • Condensers and Vacuum Pumps
Oil Burning Equipment • Rotameters
Flow Indicators • Radiafin Tubes • Valves
Spray Nozzles and Atomizers • Gear Pumps
Desuperheaters

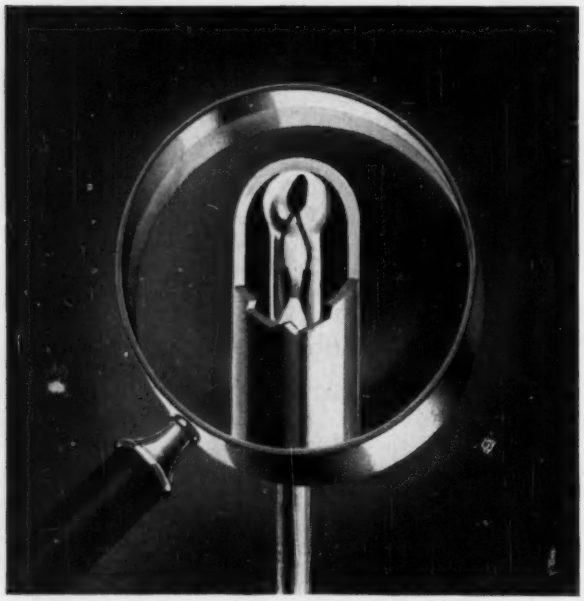
Which of these two instruments provides the temperature control accuracy you need?



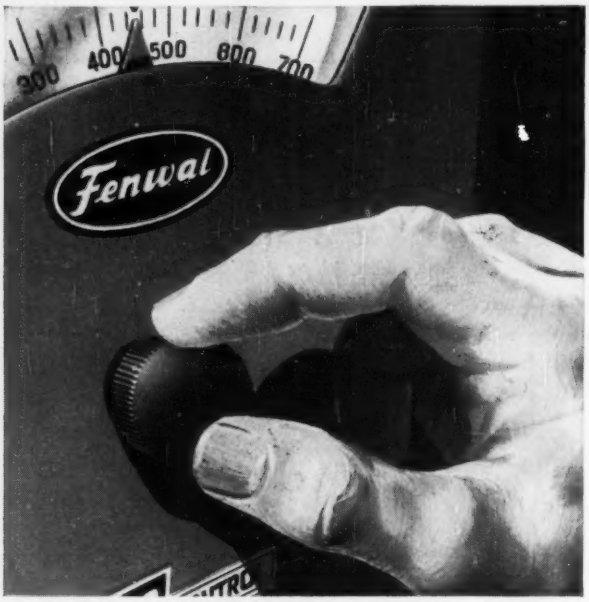
1. IT'S ELECTRONIC! The new Series 560 applies the thermistor principle in temperature indicator controls with heretofore unattainable accuracy over a scale range of 200° to 600°F. It's the *only* instrument that provides the three major control modes — (1) on-off (2) proportional (3) adjustable differential — all at the flip of a switch. Wide range of use for general laboratory, processing, molding or packaging applications.



2. IT'S MECHANICAL! The new Series 540 indicating controller combines low cost with high accuracy over a temperature range of 100° to 700°F. Temperature changes are transmitted by a bulb and bellows to an indicator control. Instrument features on-off control . . . adjustable differential . . . ambient compensation. May be flush or surface mounted. Capacity of 15 amps at 115 volts.

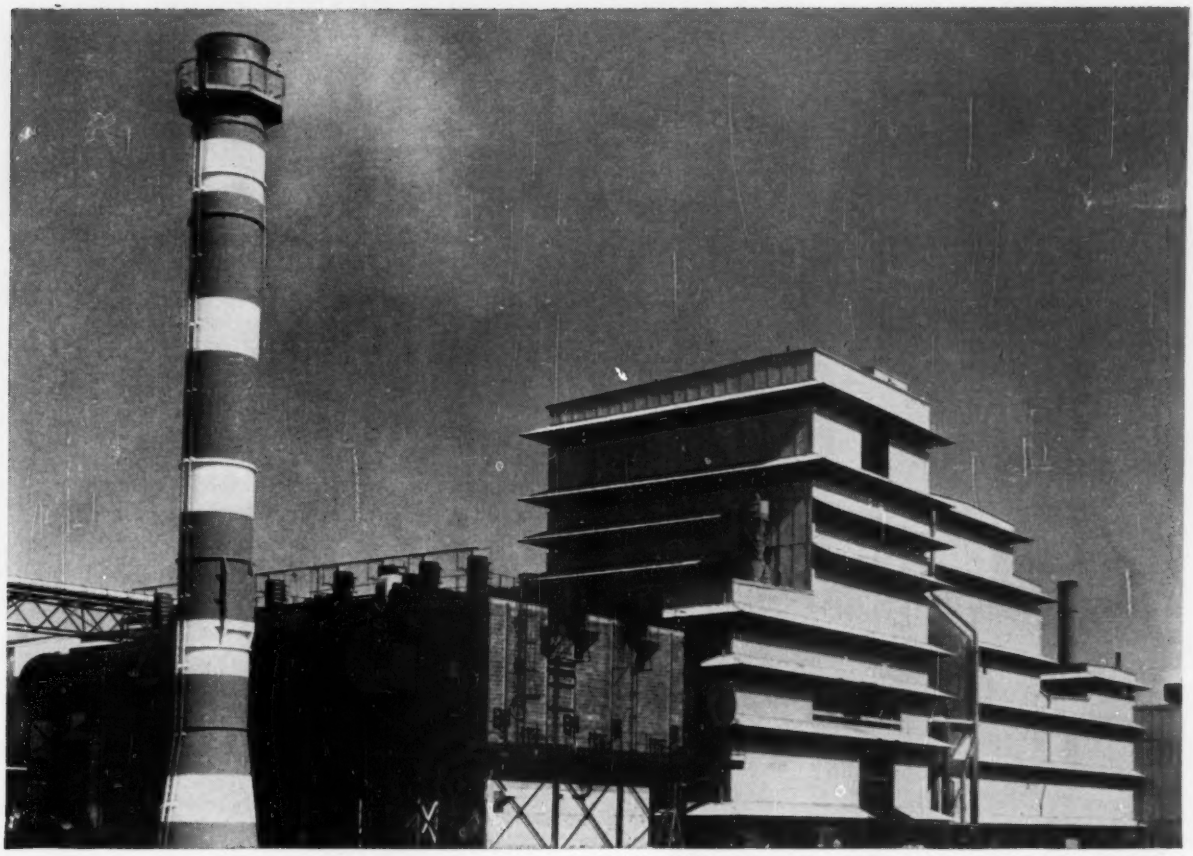


3. SIMPLICITY ITSELF is secret of Fenwal's Series 560 — accuracy, sensitivity and ruggedness. The thermistor's high resistance change permits operation with any length of lead wire up to 200 feet without affecting signal strength or accuracy. Thermistor is hermetically sealed in glass for stability; encased in stainless steel for ruggedness. No complex circuitry; maintenance is easy.



4. EASY "SET" AND "CHECK" OPERATION is a feature of Fenwal's Series 540 which is accurate to within 2% over the 100° to 700°F range, including the effects of ambient temperatures. Send for FREE NEW BULLETINS, MC122 on the Series 540, MC123 on the Series 560. Both contain full data you should have. Write to **Fenwal Incorporated, 167 Pleasant St., Ashland, Mass.**

Fenwal Controls Temperature... *Precisely*



Installation of Koppers Electrostatic Precipitator, St. Regis Paper Co. plant, Jacksonville, Fla.

Why St. Regis Paper Company Selected KOPPERS ELECTROSTATIC PRECIPITATORS

WHEN St. Regis planned to locate its new Kraft mill near Jacksonville, Florida, the entire project hinged on getting formal approval from municipal authorities.

Among other things, the zoning board required complete assurance that flue gas from the plant would not be a residential nuisance or hamper operations at a nearby airport.

To overcome any possible municipal objections St. Regis turned to Koppers to solve the gas cleaning problem.

Result: Koppers Electrostatic Precipitators not only keep the stack practically free of dust emission but also prove extremely valuable in salt-cake recovery.

Does this suggest a possible solution to your gas cleaning problems? Then contact Koppers. It is likely that Koppers, with its extensive experience in paper mill precipitator installations, can help in discussing similar equipment to satisfy your requirements. No obligation, just mail this coupon. Or attach coupon to your company letterhead.

KOPPERS

ELECTROSTATIC PRECIPITATORS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE 3, MD. This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Aeromaster Fans, Gas Apparatus.

Engineered* Products Sold with *Service

KOPPERS COMPANY, INC., *Precipitator Dept.*, 217 Scott St., Baltimore 3, Md.

Gentlemen: I am interested in a review of my gas cleaning problem.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



LITHIUM

.....the Miracle Element

"Open-Sesame" for Production-Engineering

Lithium presents properties that are stimulating to scientists, researchers and development engineers—properties that open the door to possibilities in countless fields. We can't predict what the future holds for lithium, except to note that it promises to be a bright one. It may pay *you* to investigate this wonder element. Take a long look at lithium for *your* production process.

LITHIUM

. . . lighter than magnesium or aluminum
. . . can be cut with a knife
. . . has a low melting point
. . . chemically reactive
. . . ductile, easily extruded and rolled
. . . readily melted or cast

Send for Data Sheets on any of the products mentioned here

ONE-SOURCE SUPPLIER OF LITHIUM METAL*
—SALTS—SPECIAL COMPOUNDS

LITHIUM Metal
Metal
Hydride
Amide

LITHIUM SALTS
Bromide
Chloride
Carbonate
Hydroxide

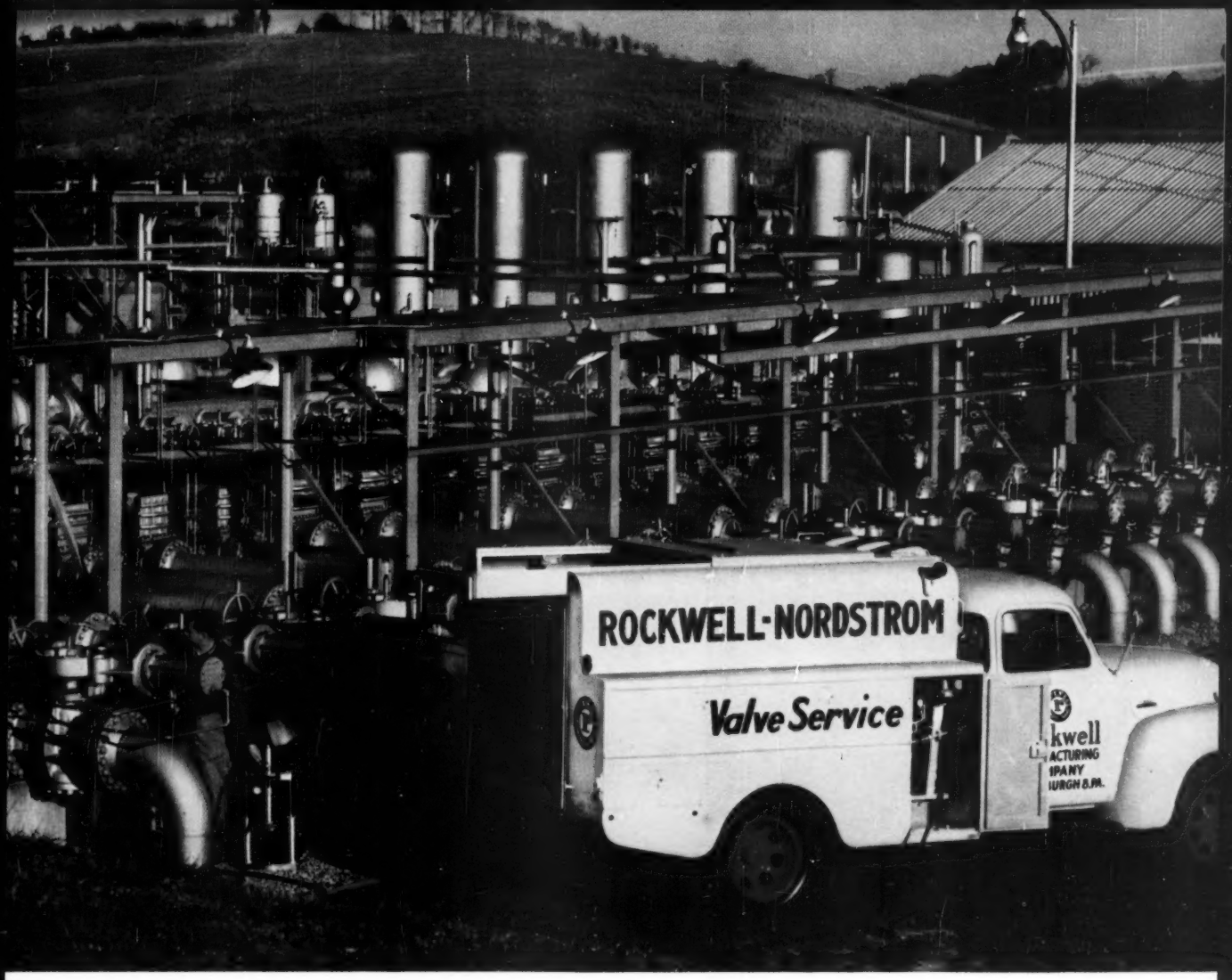
SPECIAL LITHIUM COMPOUNDS
Aluminate
(Meta) Borate
Cobaltite
Manganite
Molybdate
Silicate
Titanate
Zirconate
Zironium Silicate

*SIX FORMS

. . . trends ahead in industrial applications for Lithium.

LITHIUM CORPORATION OF AMERICA, INC.
2505 RAND TOWER
MINNEAPOLIS 2, MINN.

MINES: Keystone, Custer, Hill City, South Dakota • Bessemer City, North Carolina • Cat Lake, Manitoba • Amos Area, Quebec • BRANCH SALES OFFICES: New York • Chicago
CHEMICAL PLANTS: St. Louis Park, Minnesota • Bessemer City, North Carolina • RESEARCH LABORATORY: St. Louis Park, Minnesota



Investment in Economy

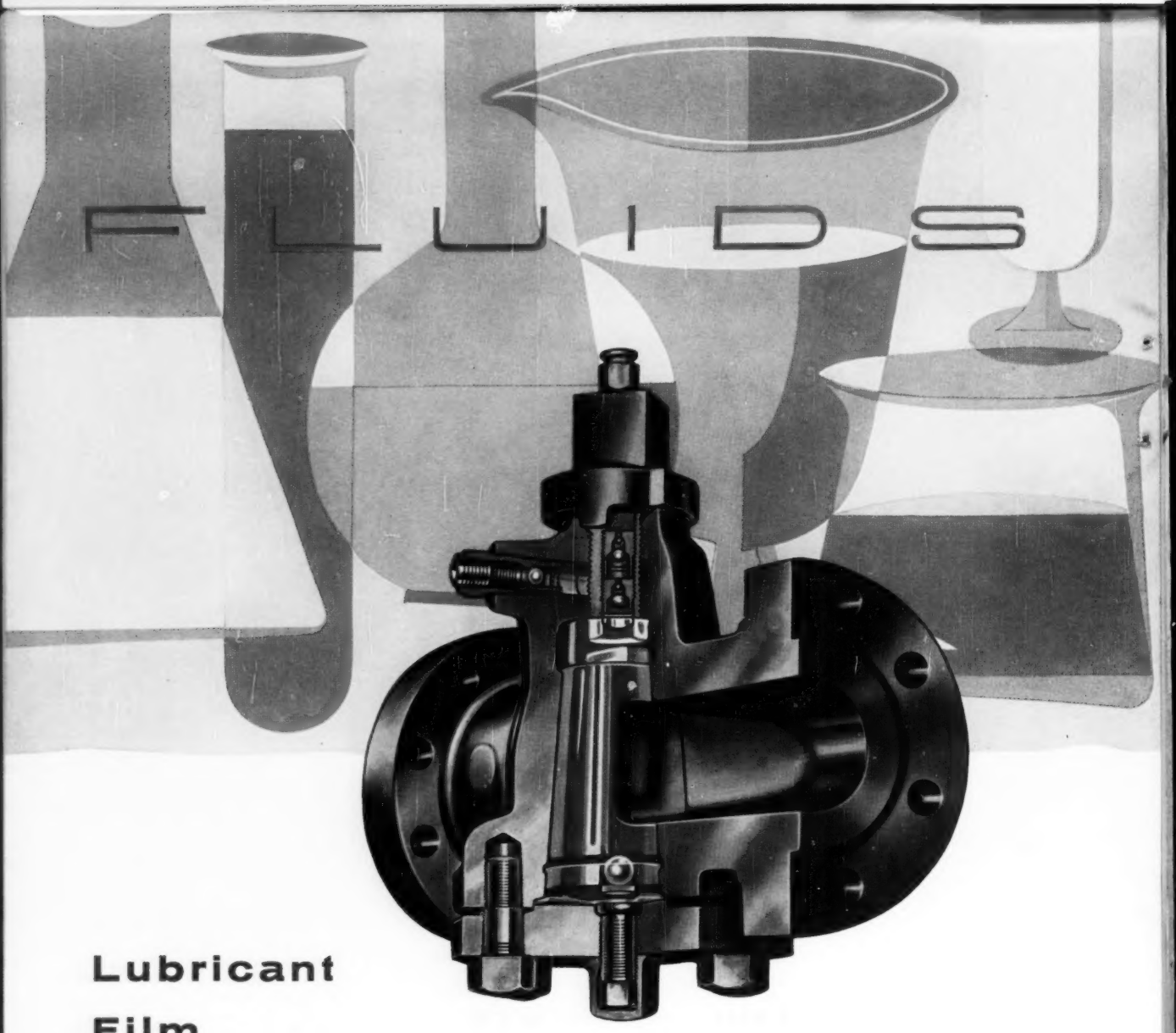
For forty years Rockwell-Nordstrom, the *original* lubricated plug valve, has built a reputation for valve economy. This year, Rockwell-Nordstrom users have even greater opportunities for valve economies through Rockwell's new mobile maintenance service, which is being made available on a contract basis.

Using the most up-to-date lubrication equipment on special Valve Lubrication Trucks, trained personnel will service all your Rockwell-Nordstrom valves on a schedule adapted to your individual requirements. These specialists will advise you on the correct Rockwell-Nordstrom lubricant for each of your services, and instruct your men on proper valve care that will allow further savings through greater efficiency and longer life.

Like Rockwell-Nordstrom valves themselves, this new Rockwell Contracted Maintenance Program has a single purpose: to give you the best valve service you've ever had, at the lowest cost per year. For complete information, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF



Lubricant Film Stops Metal-Hungry Fluids

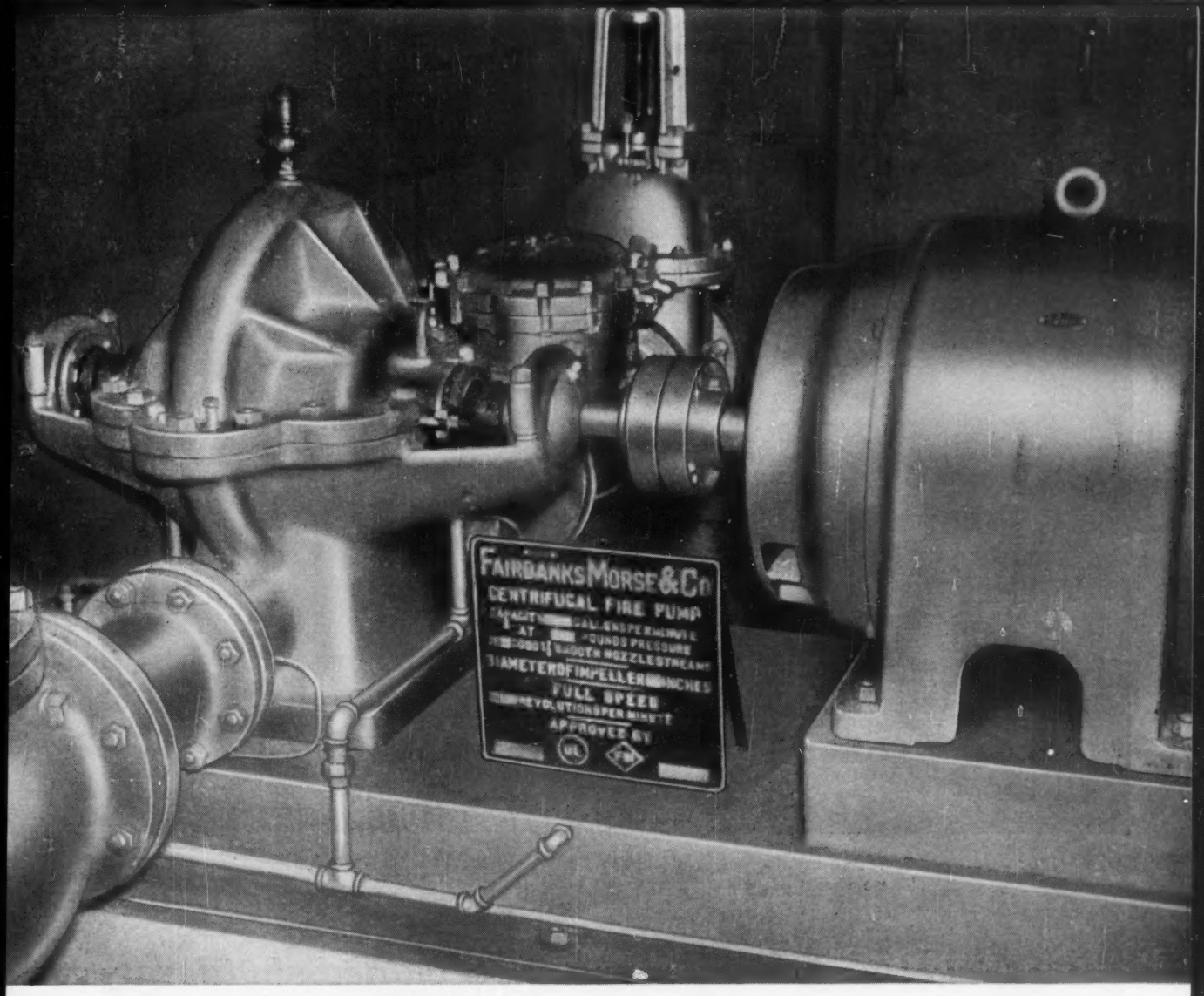
Corrosive and erosive liquids are the nemesis of ordinary valves. But the thin, tough film of pressurized lubricant in Rockwell-Nordstrom valves forms an impregnable armor plating against them. And lubricant in the Sealdport* grooving provides a pressure seal that is dependably leak proof.

On liquid lines—or on any service—Rockwell-Nordstrom valves and lubricants will do a better job, longer, for less money. For complete information related to your valve problems, write: Rockwell Manufacturing Company, Pittsburgh 8, Pa.

*a registered trademark of Rockwell Manufacturing Company

ROCKWELL-Nordstrom VALVES

LUBRICANT SEALED FOR POSITIVE SHUT-OFF



YOU CAN RELY ON YOUR FAIRBANKS-MORSE FIELD ENGINEER . . .

For Double Dependability in Fire Pumps

Plant fire protection your problem? Call in your Fairbanks-Morse Field Engineer. He's more than a salesman . . . he's an expert in solving pumping problems . . . gives you *double* dependability in the selection of the right fire pump to fit your needs.

FIRST, because he knows pumps and is also familiar with the standards established by your insurance company, he will fit the pump to your job. He has the complete Fairbanks-Morse line to back him up . . . can select the exact pump that will assure the dependability and capacity your plant needs.

SECOND, he has FAIRBANKS-MORSE pumps . . . the most efficient, dependable pumps in the field . . . made by the world's largest manufacturer of pumps.

Why not be sure of the fire pumps you buy by relying on the selection and application assistance of your F-M Field Engineer. For complete details, mail the coupon. Fairbanks, Morse & Co., 3601 Kansas Ave., Kansas City, Kansas.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY
RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

FAIRBANKS, MORSE & CO.
Pump Sales Division
3601 Kansas Ave.,
Kansas City, Kansas

Gentlemen:

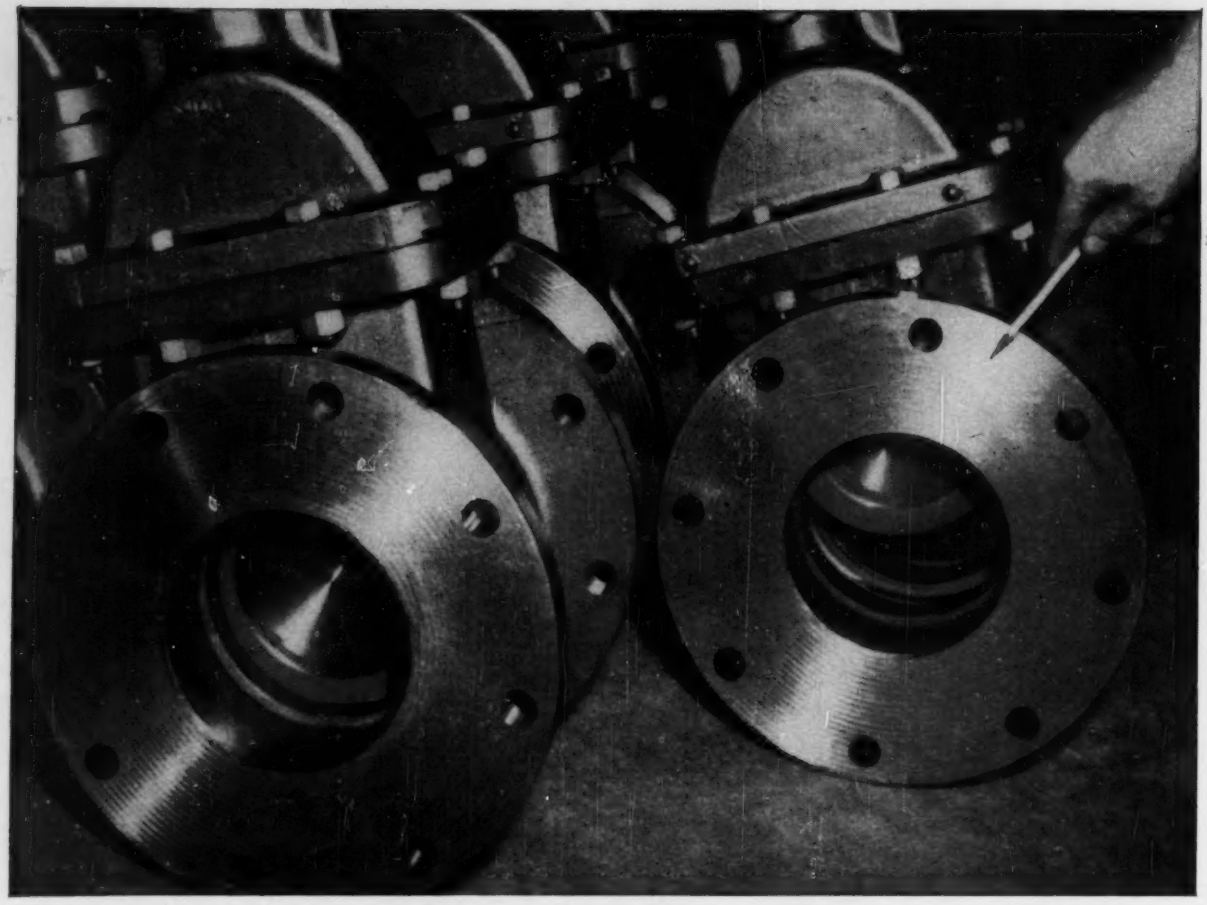
☐ I would like to have a Field Engineer review my fire pump problems.
☐ Send me informative literature on Fairbanks-Morse Fire Pumps.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



Corrosion handcuffed in alcohol-acid plant. These valves of "HASTELLOY" high nickel-base alloy assure the desired uninterrupted operation between inspections. Produced by Hasco Valve and Machine Co., Milwaukee, Wisc.

Nickel-base alloy stops unscheduled shutdowns

. . . handles 50-60% H_2SO_4 at 200-250°F

Meet some valves that show exceptional corrosion-resistance. They are made of HASTELLOY alloy D, a high nickel-base alloy.

A large oil refinery installed these valves in plants that process and concentrate sulphuric acid, which, in turn, is used for producing isopropyl and ethyl alcohol and ethers.

And here's what this user writes:

"At present, the units are on a four-month scheduled inspection and repair interval. HASTELLOY *alloy D fittings are the only ones available that do not require unscheduled shut downs for replacement and accompanying loss of production between these inspections.*

Scores of users report similar savings where equipment is exposed to strong corrosives.

You, too, may obtain excellent results by using one of the series of nickel-base alloys produced and sold under the trade-mark "HASTELLOY" by Haynes Stellite Company, Kokomo, Indiana, a Division of Union Carbide and Carbon Corporation.

Whatever your corrosion difficulty, make use of our wide practical experience. Send details of your problem for our suggestions. Write us today.

INCO TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N. Y.

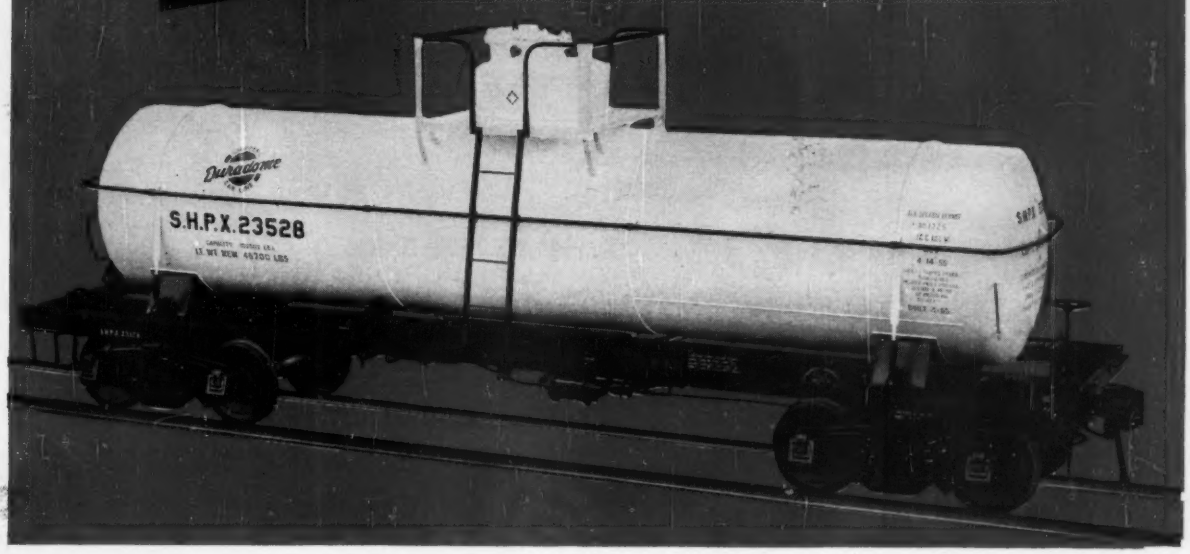
Count the extra values!

acf BUILT

DURADOME

FLUED DOME TANK CAR

acf engineering skill and a giant new million-dollar press combine to make DURADOME the most revolutionary tank car in 15 years. For only DURADOME gives you *four advanced features:*



1. Dome base flued from top center section!
2. Every tank of ring section (pressure-type) construction!
3. Standardized underframe!
4. All-welded insulated jacket!

These DURADOME features mean *far easier cleaning, better application of lining, increased structural strength* and *greater resistance to corrosion.* See your Shippers' representative for *all* the facts... let him show you how it will pay you to lease or buy the new DURADOME.

Specialists for over 35 years in the leasing, operation, maintenance and servicing of tank car fleets—now exclusive sales agent of acf tank cars for industry.

SHIPPERS CAR LINE SHPX

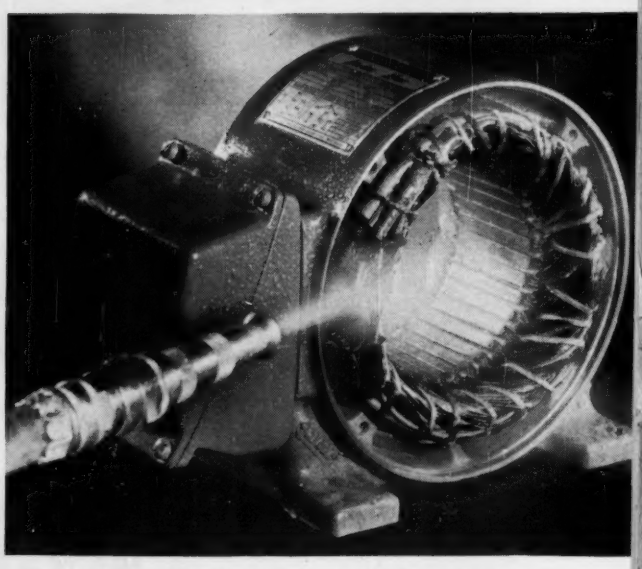
Shippers' Car Line Corporation

A subsidiary of acf INDUSTRIES, Incorporated

30 Church Street, New York 7, N.Y.

CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO.

MOTOR FACTS ON INDUSTRY'S
MOST PREFERRED "POWER PACKAGE."



Electrical System Fact—New exclusive Bondite impregnating varnish, partner to new Bondar and Mylar* insulations, guarantees complete resistance to weather. It doesn't just repel, it resists—all the way through.

*Du Pont Registered Trade-Mark

FACT:

The new Life-Line A is the most weather-resistant motor on the market

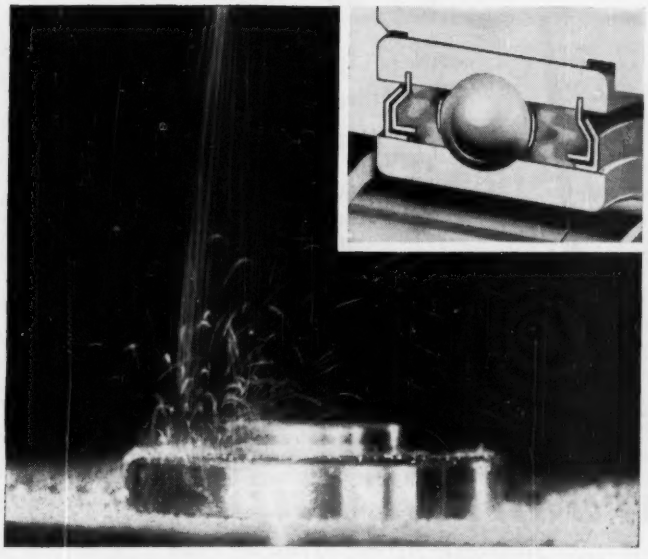
Whether your application is hot—cold—wet or dry, you'll find the new Westinghouse Life-Line® "A" motor will last longer under more extreme weather conditions than any other motor you can buy.

New insulation materials, housing designs, 4-way sealed bearings are tangible evidence of electrical, mechanical and lubrication system improvements that make Life-Line "A" industry's most preferred package of power.

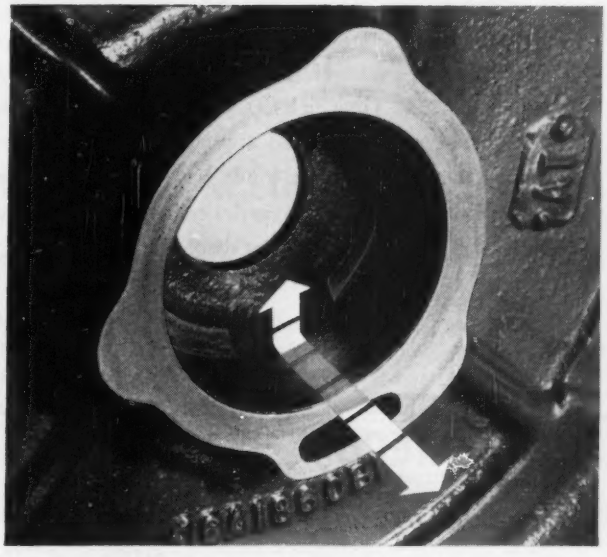
Get all the facts by calling your Westinghouse sales engineer . . .
The Man With The Facts.

J-21882

YOU CAN BE SURE...IF IT'S Westinghouse



Lubrication System Fact—Two outer seals of new 4-way sealed bearing act as flingers and literally (see photo above) throw off damaging contaminations. Inner seals, attached to outer bearing race, are stationary and form a positive labyrinth with outer seals.



Mechanical System Fact—New exclusive air by-pass on totally-enclosed motor permits the motor to breathe around the bearing—not through it—minimizing atmospheric damage. Finest grained castings used in new cast-iron housings.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND

AN AIR REDUCTION PRODUCT

PURECO

CO_2

DOES THESE MANY JOBS AND MORE...

CO_2 as an Inert Gas for

- PHARMACEUTICALS
- DYES
- PAINT
- LACQUER
- PACKAGING
- PURGING TANKS AND MAINS
- INERT PRESSURE TRANSFER
- FUMIGANT CARRIER
- CAPSULATING
- EXPLOSIVES
- POWDERING
- FLUSHING MOLTEN METALS

CO_2 as a Refrigerant for

- PHARMACEUTICALS
- DYES
- PAINT
- PLASTICS
- LACQUER
- INSECTICIDES
- RESINS
- RUBBER TRIMMING
- VACUUM TRAPS
- LOW TEMPERATURE TESTING
- EXPLOSIVES
- LYOPHILIZING (low temperature drying)

CO_2 as an Active Ingredient for

- PHARMACEUTICALS
- TIN PLATE TESTING
- ASBESTOS CEMENT CURE
- CARBONATION
- PH CONTROL
- FOAM PLASTIC
- FOAM RUBBER
- WATER TREATMENT
- MANUFACTURE OF CARBONATES

Today, chemical and processing industries are putting CO_2 through its paces . . . making it perform in imaginative and diverse ways — to the satisfaction of researchers and production men everywhere. Here are some applications in which CO_2 emerges with flying colors. If they suggest related applications in your processing methods, then we would be pleased to discuss them with you. Our wide experience in applying CO_2 to industrial problems is at your disposal.

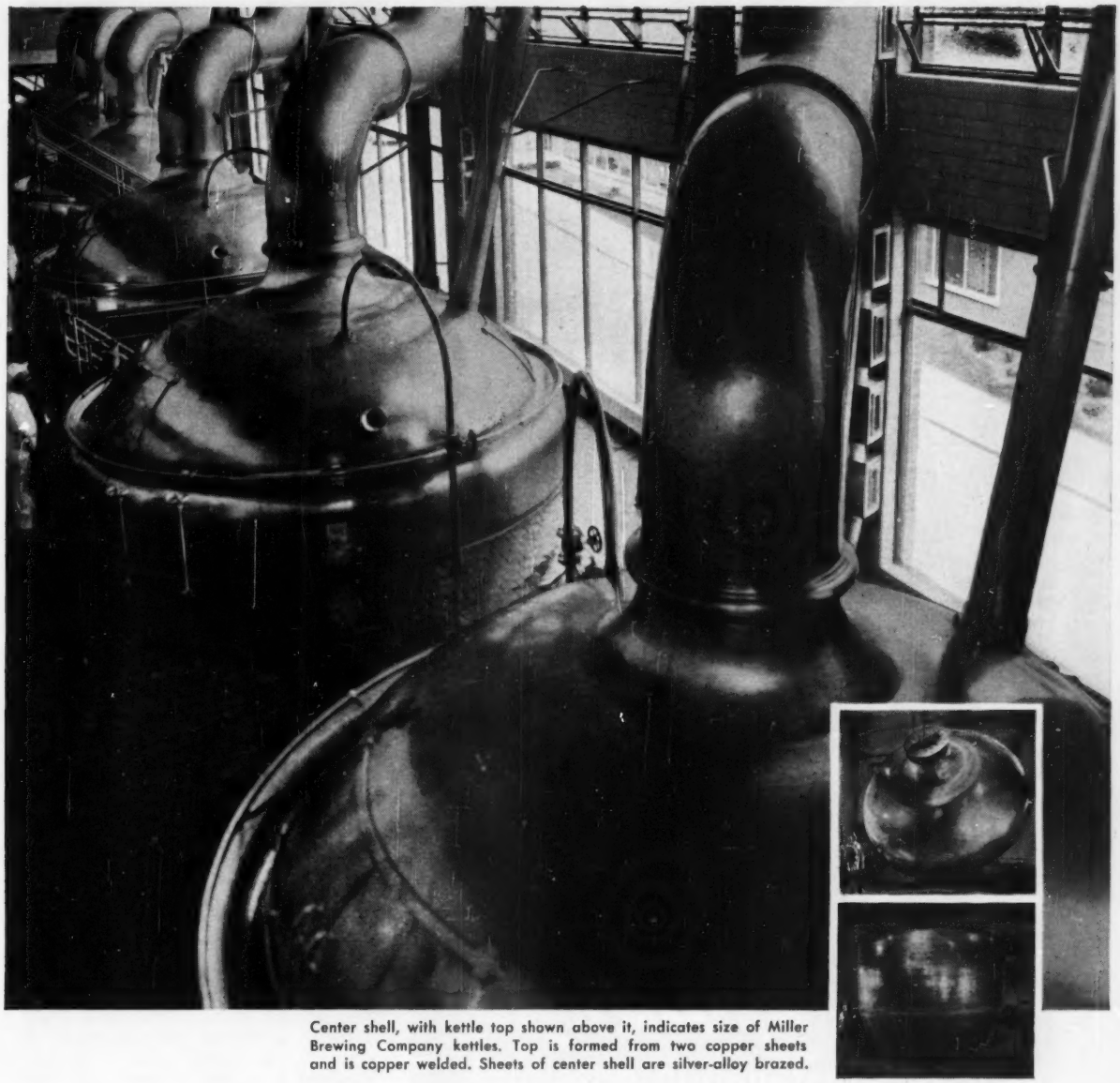
PURECO

Pure Carbonic Company

NATION-WIDE "DRY-ICE" SERVICE-DISTRIBUTING STATIONS IN PRINCIPAL CITIES

GENERAL OFFICES: 60 EAST 42ND STREET, NEW YORK 17, NEW YORK

PURE CARBONIC COMPANY *is a division of* **AIR REDUCTION COMPANY, INCORPORATED** *Principal products of other divisions include:* **AIRCO**—*industrial gases, welding and cutting equipment and acetylenic chemicals* **OHIO**—*medical gases and hospital equipment* **NATIONAL CARBIDE**—*pipeline acetylene and calcium carbide* **COLTON**—*polyvinyl acetates, alcohols and other synthetic resins.*



Center shell, with kettle top shown above it, indicates size of Miller Brewing Company kettles. Top is formed from two copper sheets and is copper welded. Sheets of center shell are silver-alloy brazed.

500-barrel copper brew kettles take super-size Anaconda copper sheet

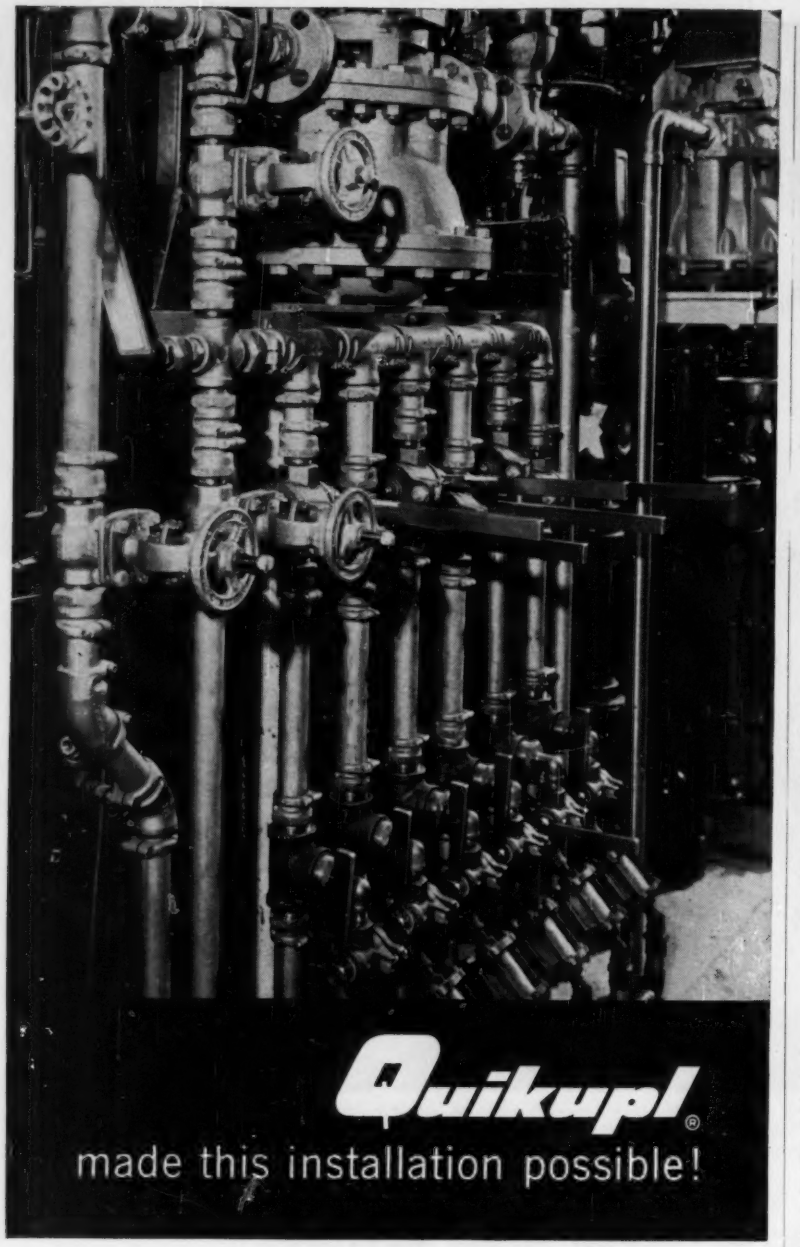
The copper brew kettles you see here each hold 15,500 gallons of Miller High Life Beer. They are designed and fabricated to Miller's specifications by an old hand at brewery copper work—115-year-old Deckebach Sons Company of Cincinnati, a division of Brighton Copper Works, Inc. Deckebach called on the metallurgical and manufacturing abilities of Anaconda to produce the unusually large size copper sheet in the heavy sections they needed for the job. Anaconda copper sheets as large as 117" x 234" x .134" were used.

The kettles are made of copper; in addition, the bottoms are encased by steam jackets made from Everdur* circles 136" in diameter and ½" thick. Everdur is an Anaconda Copper-Silicon Alloy with high corrosion resistance. Each kettle and jacket contains about 7 tons of copper and Everdur. Body seams are silver-alloy brazed and the two-piece tops are copper welded.

Anaconda mills, warehouses and distributors throughout the country are always ready to give you fast service when you need copper, brass, bronze in sheet, plate, wire, rod and tube. At most locations, you can also have metal sawed, slit or sheared to exact sizes. If special problems arise, write directly to *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.* 55112

*Reg. U. S. Pat. Off.

ANACONDA®
COPPER & COPPER ALLOYS



Take a good look at this manifold installation which forms part of the modern de-ionization system at the Johnson and Johnson Baby Products plant in Cranford, New Jersey. Its neat, compact appearance tells more than words.

Put up in a jiffy, without threading, welding or flaring, in a room less than three feet wide, QUIKUPL stainless steel fittings enabled Plant Engineer Stephen Baksa to install more than 300 feet of 1½ O.D. stainless tubing in record time and at low cost. "When you take installation into consideration," says Mr. Baksa, "QUIKUPL costs are so low that I even specified them on the drain line."

Find out how QUIKUPL can save you valuable installation time and dollars. Write for Bulletin Q100 today!

COOPER ALLOY
CORPORATION • HILLSIDE, N. J.
Valve & Fitting Division

COOPER ALLOY CORPORATION BRIEFS

• Edited by GEORGE BLACK

VALVE TECHNICAL DATA

A preprint of the technical data section of the forthcoming COOPER ALLOY Valve and Fitting Catalog is available on request. It contains diagrams, design data, cutaway photos, selection, maintenance and repair hints and information on special types and operating mechanisms. Please ask for VALVE TECHNICAL DATA.

DEPENDABLE PUMPING IS KEY

The key to the successful operation of an oxygen analyzer designed for the continuous measurement of oxygen in gaseous streams is the dependability of the Vanton polyethylene pump with neoprene "flex-i-liner" which pumps cuprous ammonium chloride 24 hours a day, 7 days a week, with complete assurance against corrosion or contamination. Full story on request.

RESEARCH UNVEILS NEW ALLOYS

The latest result of Cooper Alloy Advanced Know-How is a new series of precipitation hardenable stainless alloys designed to fill the following needs: 1) a ductile high strength alloy of medium hardness 2) a high strength and high hardness alloy with fair ductility 3) a very high hardness alloy of low ductility. All three alloys have excellent corrosion resistance—equal or superior to type 316 stainless. More complete data on request.

QUIKUPL® CUTS COSTS

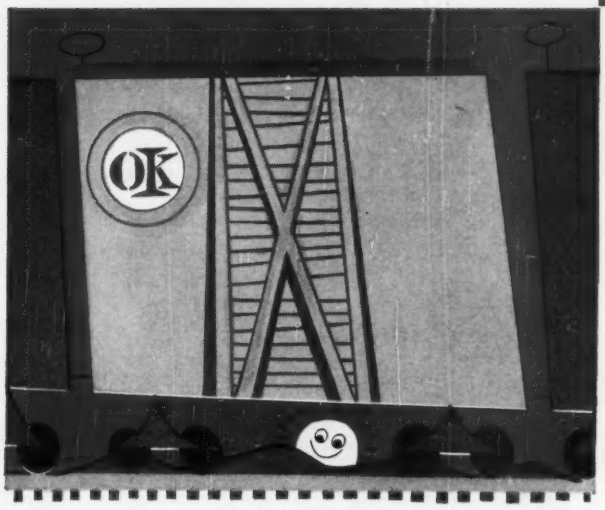
A series of interesting case histories showing how Quikupl—the patented stainless steel fitting which can be assembled and disassembled without threading, flaring or welding—cuts time and costs, appears in a recent issue of NEWSCAST. If you're not on the regular mailing list for this bi-monthly technical magazine, ask for your free copy of the May issue.

COOPER ALLOY
CORPORATION • HILLSIDE, N. J.

When you specify Kaiser Alumina . . .



Your order gets immediate, individual attention . . .



You get prompt delivery . . . often overnight in emergencies!



You get experienced technical service!

THAT'S WHY Kaiser Chemicals has become a major supplier of calcined and hydrated aluminas serving more than eighty percent of the nation's users.

Whether you make abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly.

Call or write Kaiser Chemicals Division, *Kaiser Aluminum & Chemical Sales, Inc. Regional Sales Offices: 1924 Broadway,* OAKLAND *12, California . . . First National Tower,* AKRON *8, Ohio . . . 518 Calumet Bldg., 5231 Hohman Avenue, Hammond, Indiana* (CHICAGO).

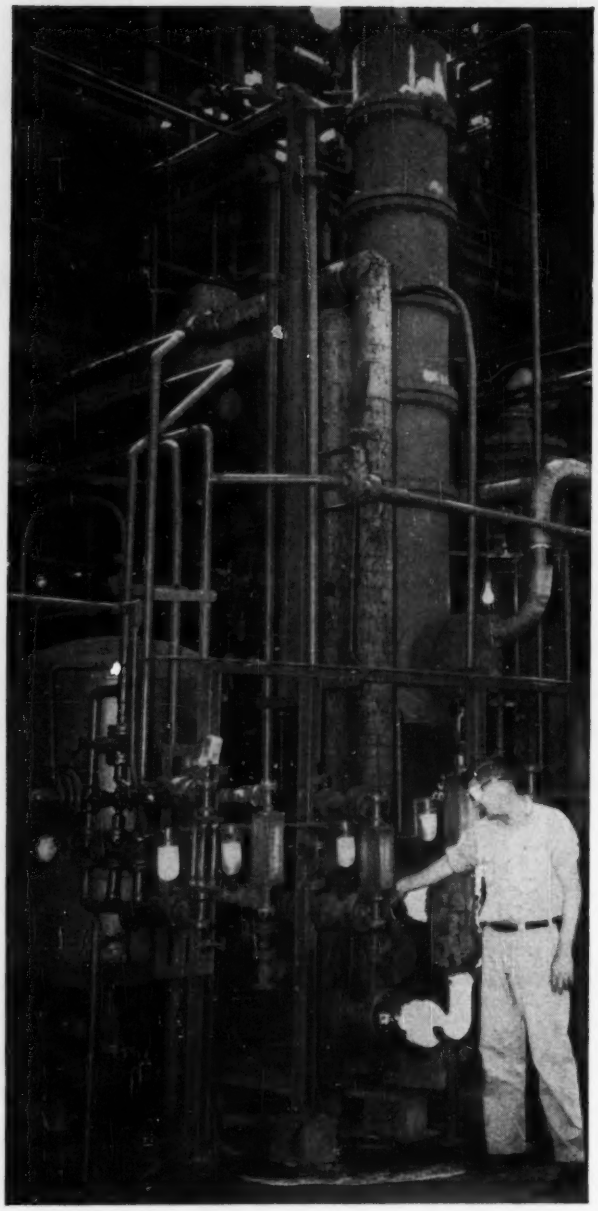
See our complete listing in Chemical Week Buyers Guide.

Kaiser Chemicals

calcined and hydrated aluminas

Alumina • Basic Refractory Brick and Ramming Materials • Dolomite • Magnesia • Magnesite • Periclase

Operating experience over a long period of years has proved that Monel and Nickel are highly satisfactory materials for handling chlorinated solvents. A large Southwestern chemical plant uses this Monel equipment in the handling of moist carbon tetrachloride.



Where chlorinated solvents *act up...* Nickel and Monel *stand up!*

Chlorinated hydrocarbons are not exactly corrosives — but they frequently get out of hand.

And when they do, the intensity of their attack varies all over the lot.

Temperatures and pressures have their effects, as do differences in the nature and purity of the solvent itself.

Where there is corrosion, it is due largely to the hydrochloric acid formed by decomposition in the presence of water. Some metallic materials are not only attacked by the acid — *they actually catalyze the reaction!*

What's the answer to this problem? A simple one — use Nickel or Monel for your equipment. *Both have the ability to resist dilute HCl.*

What's more, both are inherently strong, an added property which justifies their wide-spread use as construction materials for such equipment as distillation units . . . degreasing units . . . dry cleaning systems . . . recovery stills and condensers . . . storage tanks.

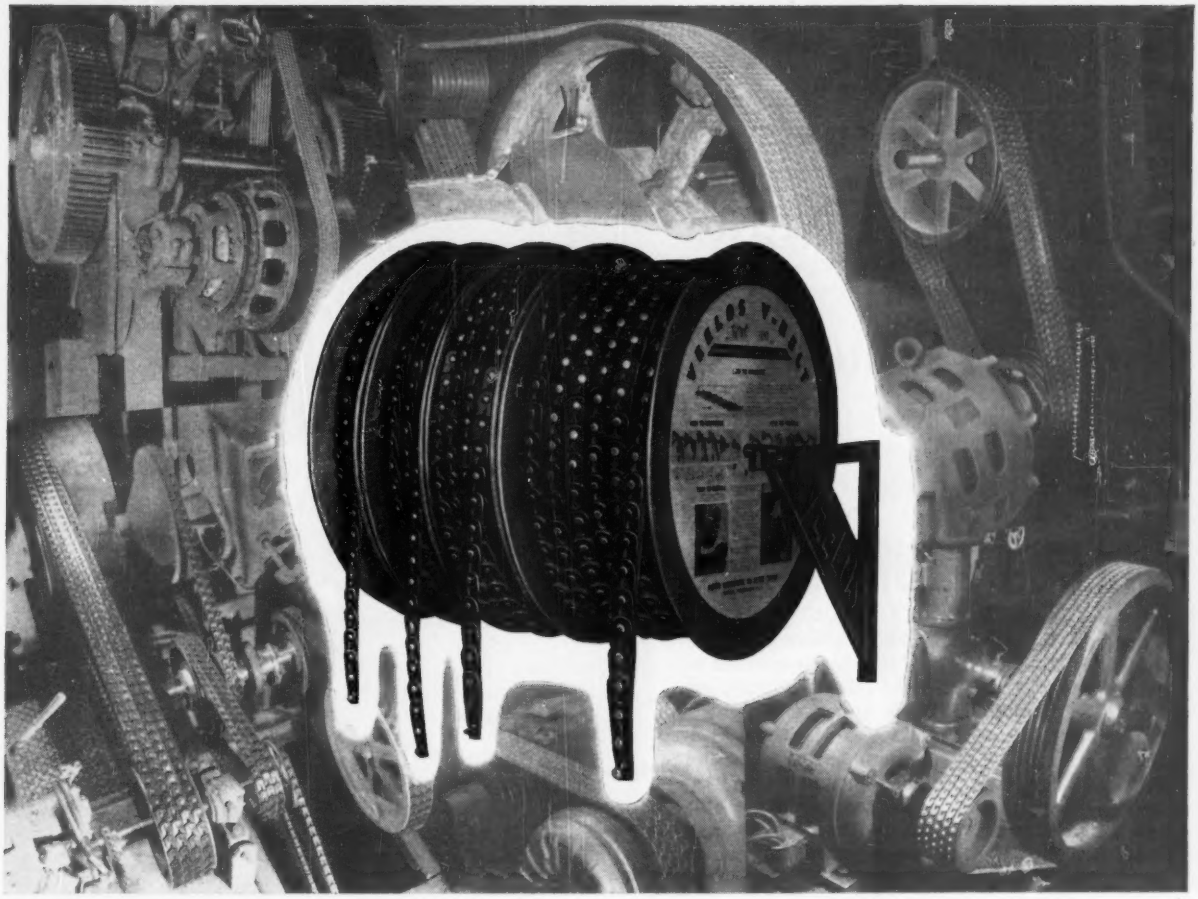
Where heavy equipment is involved, the *cost* of it may cause some pencil sharpening. So remember this — you can keep costs down by using Lukens Nickel-Clad (or Monel-Clad) Steel. Here, a relatively thin layer of Nickel or Monel is metallurgically bonded to a heavy steel plate. Lukens clad steels afford economical resistance to many corrosive agents, and safeguard the products handled from contamination or discoloration.

Detailed information on the *Resistance of Nickel, Monel and Other High-Nickel Alloys to Corrosion by Hydrochloric Acid, Hydrogen Chloride and Chlorine* is to be found in *Technical Bulletin T-29*. We'll be glad to mail you a copy on request. And of course Inco's Corrosion Engineering Section is always ready to help you with specific problems dealing with the handling of chlorinated solvents. Be sure to call on them when you need help.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK **Nickel Alloys**

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL "S"® MONEL • INCONEL® • INCONEL "X"® INCONEL "W"® • INCOLOY® • NIMONIC® Alloys NICKEL • LOW CARBON NICKEL • DURANICKEL®



THIS *one* V-BELT INVENTORY
keeps your drives on the go

Take a look at the illustration above—there's a *complete* v-belt inventory. Those four 100-foot reels of Veelos—the adjustable v-belt—in the O, A, B and C widths can replace up to 316 different sizes of endless v-belt. Of course, when you use only one or two widths of v-belt, you stock reels of only those widths. This 4-reel Veelos v-belt inventory is easy to maintain, stores in a space only 16 inches square, and is ready when you want it.

But inventory saving is just a part of the Veelos story.

Veelos adjustable v-belt is *easier to install*—in many cases installation is completed in 50% to 90% less time.

Using Veelos means you don't have to re-set motors or remove outboard bearings. Veelos v-belts provide *vibrationless, full power delivery*. A demonstration on an electronic vibration analyzer will show you and prove to you that Veelos v-belts *reduce vibration up to 90%!*

Switch to Veelos adjustable v-belt—the one v-belt that keeps your drives on the go. See your Veelos distributor. Write for your copy of the facts-packed Veelos Data Book.



MANHEIM MANUFACTURING & BELTING COMPANY
602 Manbel Street, Manheim, Penna.

VEELOS
THE BALANCED
LINK V-BELT

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Veelos is packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. VEELOS is known as VEELINK outside the United States.

2012

Handling Ammonium Nitrate and Nitrogen Solutions?

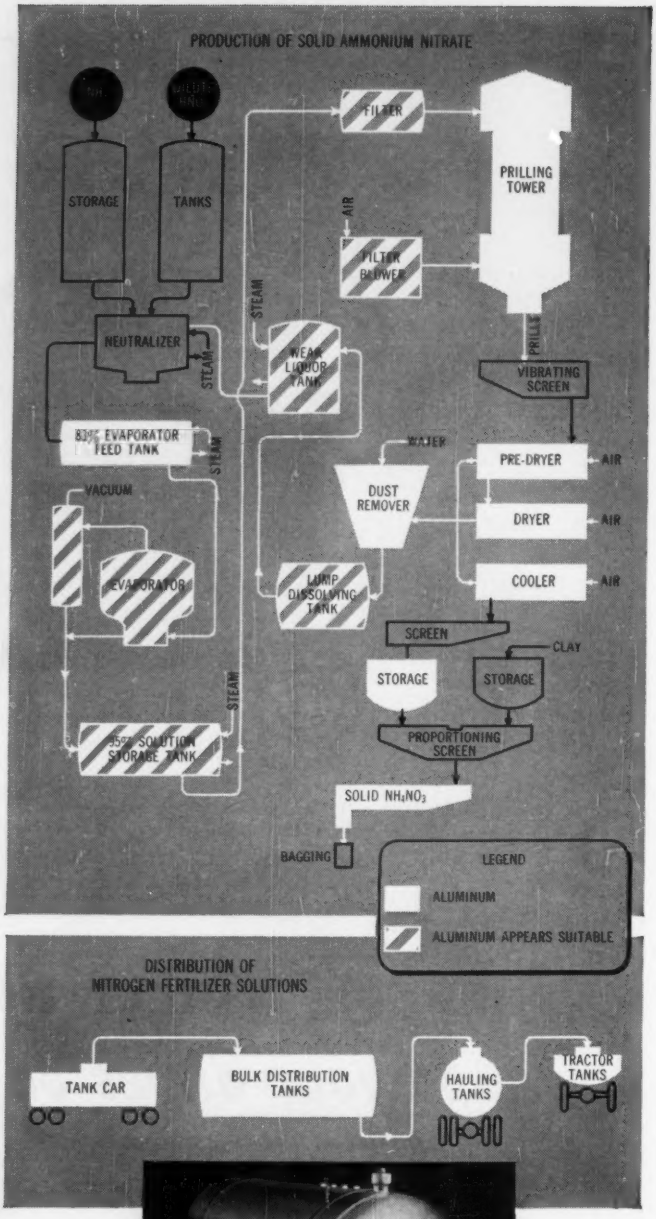
Do it better, cheaper...with

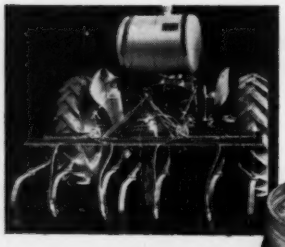
ALCOA ALUMINUM

Almost from the time its ingredient, natural gas, is first taken from the earth until it is finally returned as fertilizer, AMMONIUM NITRATE and its solutions are handled extensively in ALCOA Aluminum.

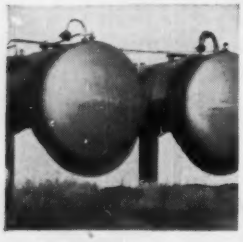
For example, ammonia tanks, nitrogen chilling exchangers, prilling towers, tank cars, piping, drums and solution storage tanks of ALCOA Aluminum have been in service for years. Aluminum does not render the nitrate unstable. Moreover, ALCOA Aluminum for floor grating, structural members, housings, roofing, siding, smokestacks, sash, doors, trim, drainage trench lining, electrical fittings and devices, instrument lines and electrical conduit is giving excellent service in ammonium nitrate plants.

AMMONIUM NITRATE, AMMONIATED, does not attack aluminum. Aluminum pressure vessels, storage tanks, piping and tank cars are excellent for handling these nitrogen fertilizer solutions.





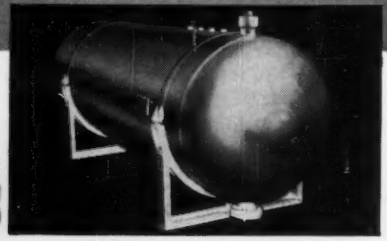
ALCOA NITROGEN FERTILIZER STORAGE TANKS are designed for pressure or nonpressure service. Capacities range from 5,000 to 22,000 gallons.





ALCOA APPLICATOR TANKS have standard capacities of 55, 75, 100 and 200 gallons.

INJECTION TANKS. Alcoa's standard 55 gallon general purpose drum is readily adaptable as a fertilizer injection tank on the suction side of irrigation systems.

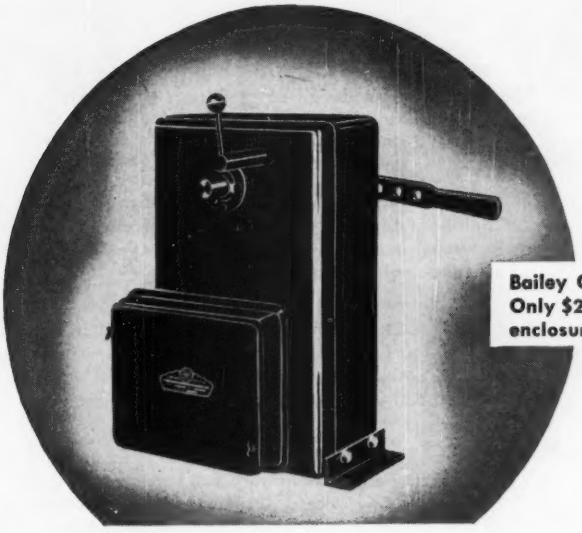


ALCOA TRANSPORT OR FARM STORAGE TANKS, in 550 or 1,000 gallon capacities, are easily mounted on wagon. No floor required.

FREE. New ALCOA book, *Process Industries Applications of Alcoa Aluminum*, 80 pages of performance and design data. Write today.

ALUMINUM COMPANY OF AMERICA
903-G Alcoa Building, Mellon Square
Pittsburgh 19, Pennsylvania

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F. O. B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

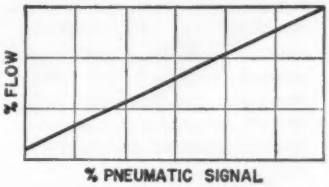
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

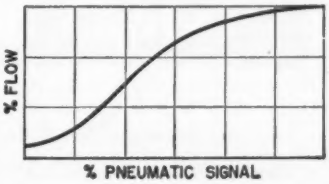
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



BAILEY METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

Complete Controls for Process Plants

BAILEY METERS

Controls for

TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

FOR MORE INFORMATION
FILL OUT AND MAIL

☐ I am interested in Bailey Control Drives. Mail me Spec. CA040

☐ I am interested in Bailey Control Linkage. Mail me Spec. CA942B

Name_____

Title & Company_____

Street & Number_____

City & Zone_____ State_____

DON'T OVERLOOK JOBS THE AXIAL FLOW DOES BEST!

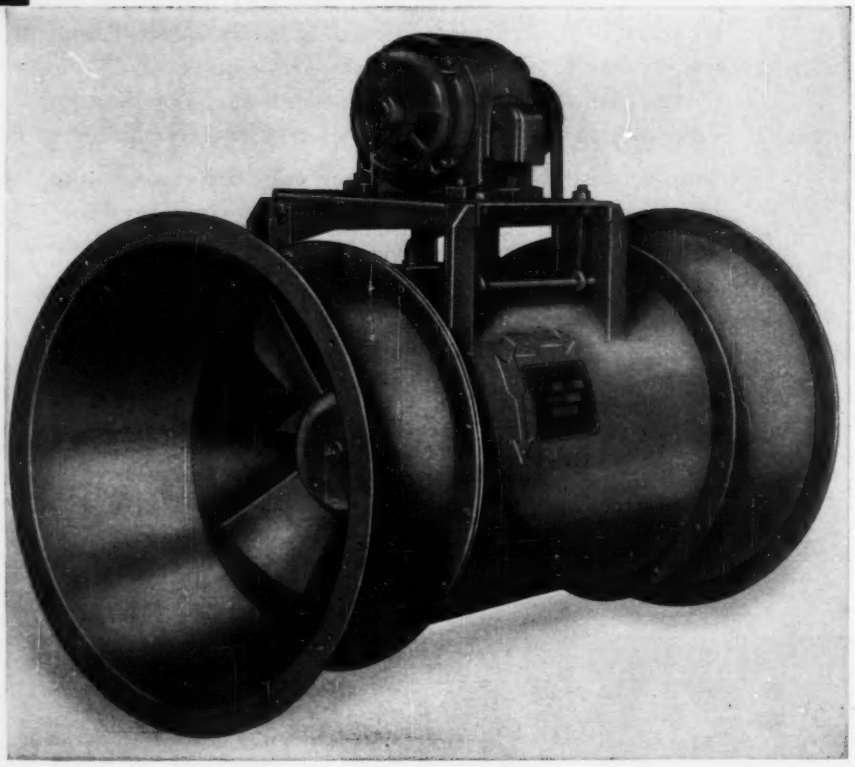
The axial flow fan design offers distinct advantages well worth considering for a growing variety of jobs:

1. STRAIGHT LINE EFFICIENCY. Being basically designed for duct mounting, the axial flow is at its best when mounted in straight duct runs. "Buffalo" Axial Flows are giving excellent service as duct-mounted "boosters" in systems—also as light-duty ventilation, exhaust and industrial air conditioning supply fans.

2. LIGHT WEIGHT. This permits economical installation. In all but the very largest sizes, no heavy foundations or structural support are required. "Buffalo" Axial Flow Fans are often installed as part of the pipe or stack in hood and vat or other roof exhaust systems.

3. SPACE SAVINGS. These duct-size fans fit in close to walls or ceilings. Space-saving applications vary from paint spray booth exhaust to forced draft for cooling towers — from circulation of chilled air in quick freezing to boiler room cooling. Here, high efficiency influences the choice, as well as compact size.

Naturally, all axial flow fans are not alike. When you specify "Buffalo", you assure your customer the top performance inherent in the "Q" Factor*. Write today for Bulletin 3533-EF for full details.



Right, "Buffalo" Type "B" Vaneaxial Fan. Outlet guide vanes smooth out air flow for greatest efficiency and quiet operation. Available for high or low temperatures, corrosive fumes, explosive atmospheres, etc.

NOTE: No one fan is the answer to every problem. "Buffalo" builds all types, including broad lines of centrifugal and propeller fans. Full details on request.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

BUFFALO FORGE COMPANY

501 BROADWAY BUFFALO, N. Y.

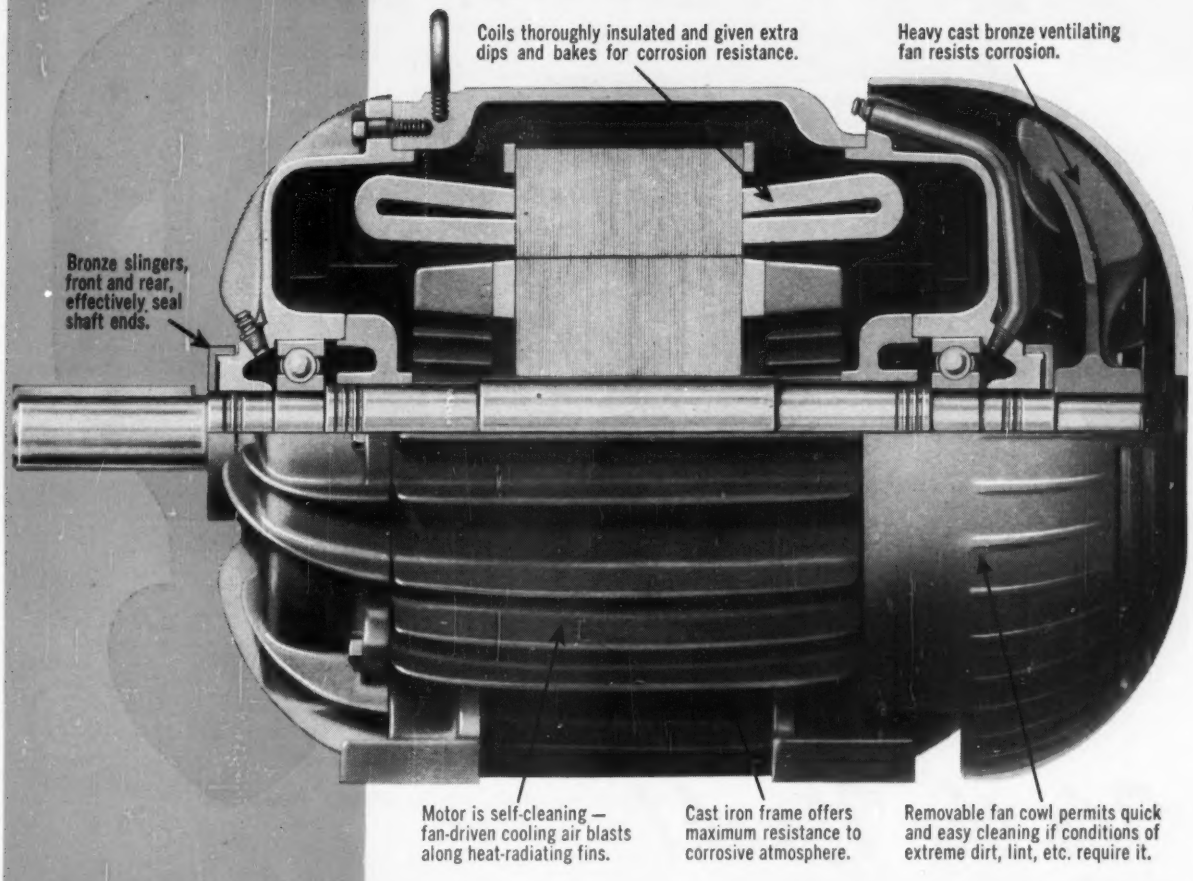
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

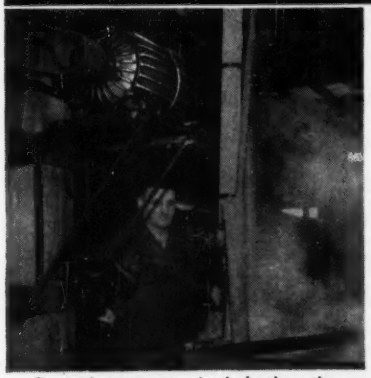
Sales Representatives In All Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Here's the motor for TOUGH process plant service



The ELLIOTT C-W Chemical Motor



Corrosive vapors don't bother the Elliott C-W Chemical Motor.

• Corrosive fumes and vapors cannot invade this totally-enclosed, fan-cooled motor. It's the famous Elliott C-W *Sealedpower* motor, specially modified to give full protection in rugged process plant service where salt, sulfur, acid and alkali atmospheres are present. And, as with all *Sealedpower* motors, it's cool-running and self-cleaning so that you get top operating efficiency as well as extra protection. The Elliott C-W Chemical Motor is available in any NEMA frame from CFC 225 through CFC 505. For details, ask your local Elliott Field Engineer or write Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.

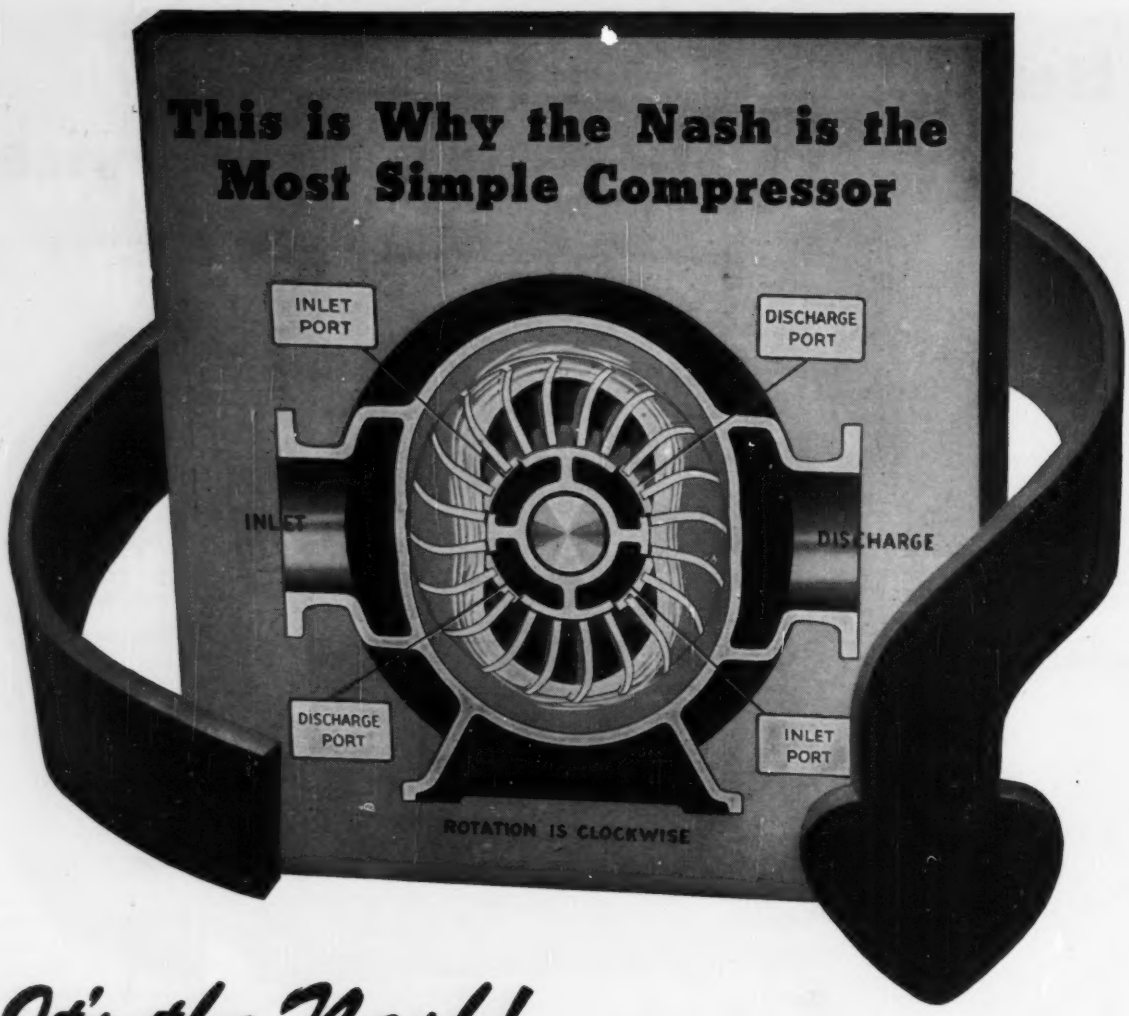
ELLIOTT Company

WS-5



TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

When You Talk Chemical Shipping . . . You Talk OUR Language!

And we talk yours. Our knowledge of transportation is serving the chemical industry every day throughout the nation, right along with specially designed North American tank cars that deliver chemical products safe, sure, clean and pure in markets from coast to coast. Special lined North American cars eliminate contact with metal, corrosive action, contamination. Your chemical shipping problems are our business, and we talk your language in solving them.

NORTH AMERICAN CAR CORPORATION

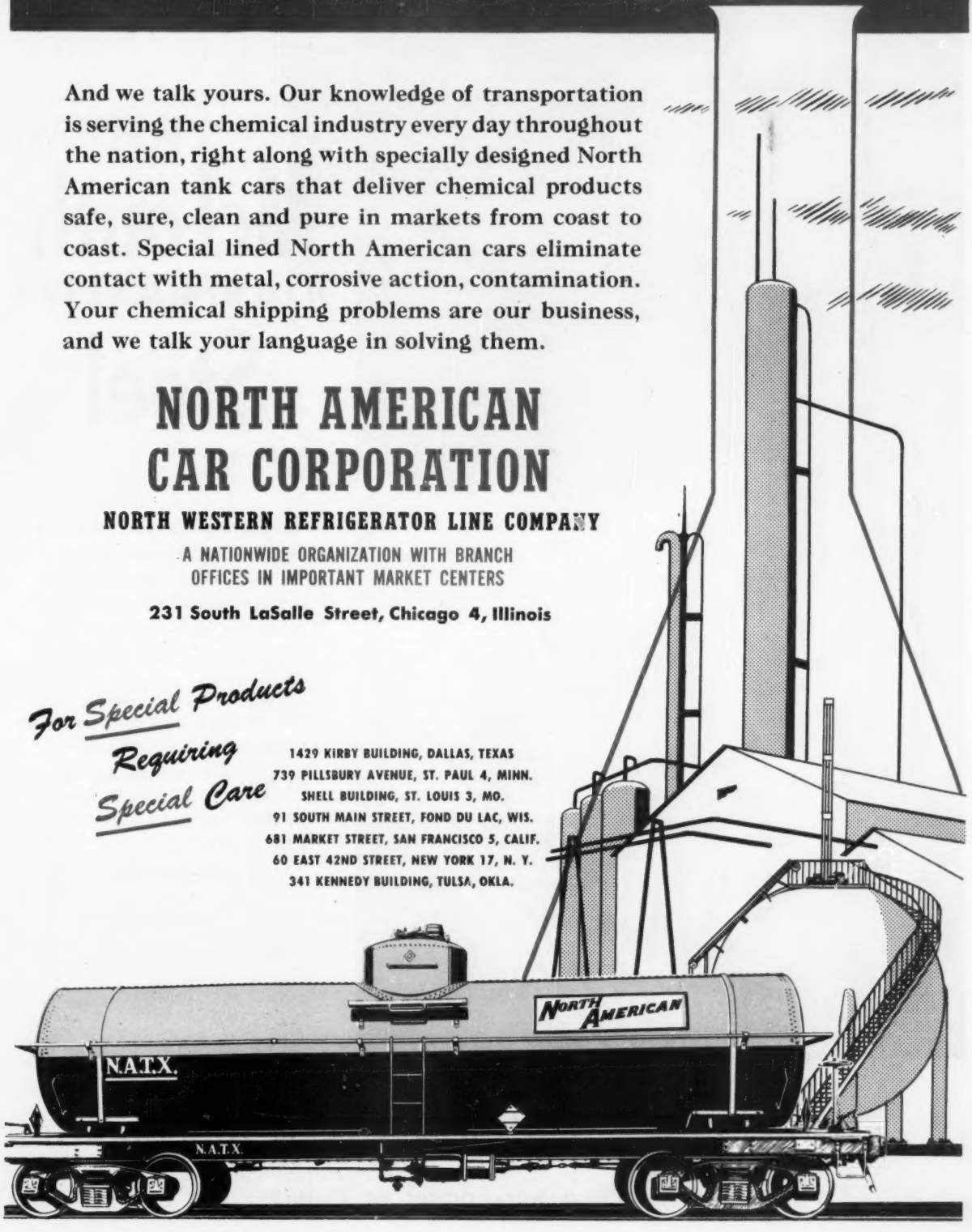
NORTH WESTERN REFRIGERATOR LINE COMPANY

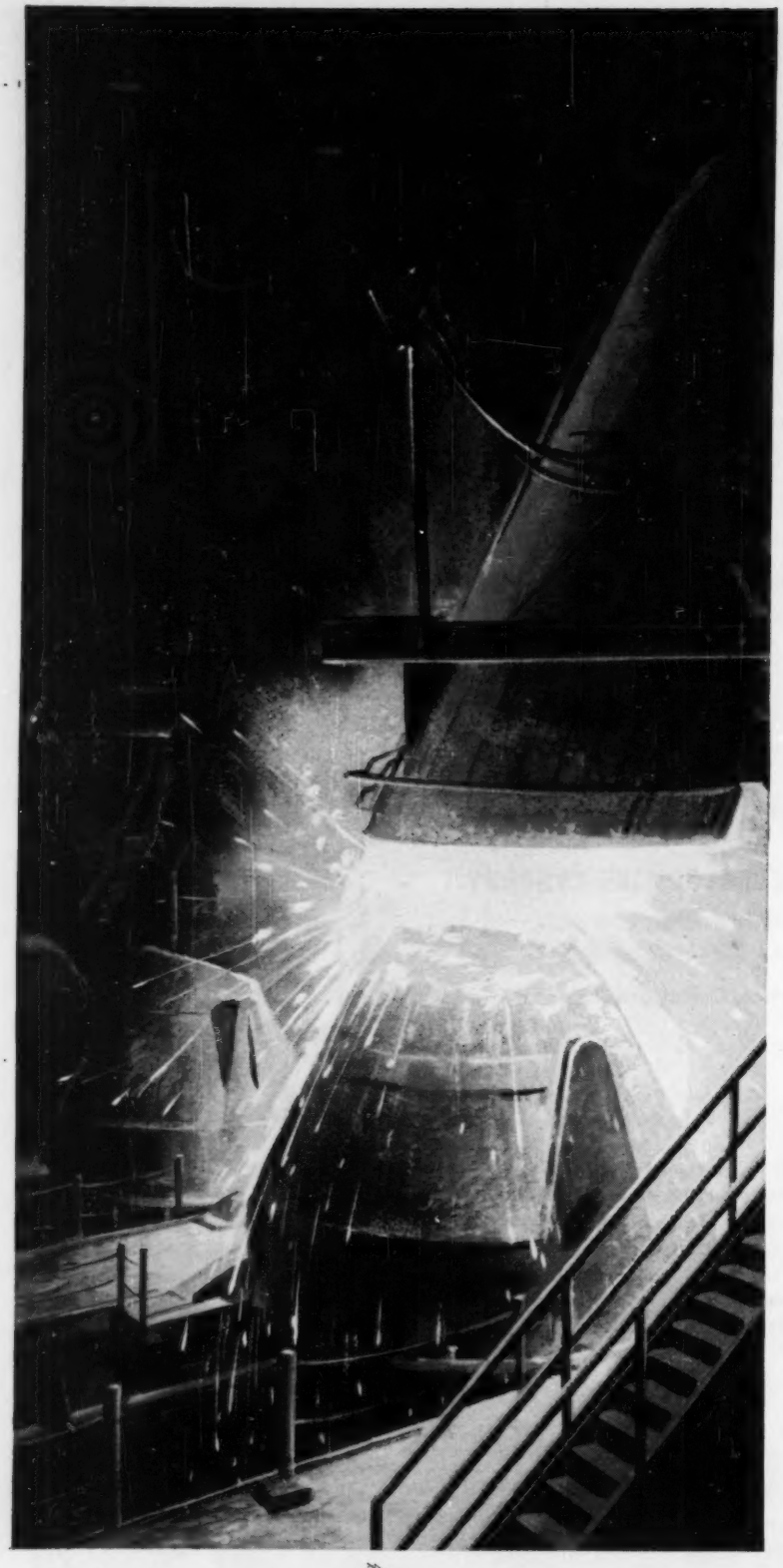
A NATIONWIDE ORGANIZATION WITH BRANCH OFFICES IN IMPORTANT MARKET CENTERS

231 South LaSalle Street, Chicago 4, Illinois

For Special Products Requiring Special Care

1429 KIRBY BUILDING, DALLAS, TEXAS
739 PILLSBURY AVENUE, ST. PAUL 4, MINN.
SHELL BUILDING, ST. LOUIS 3, MO.
91 SOUTH MAIN STREET, FOND DU LAC, WIS.
681 MARKET STREET, SAN FRANCISCO 5, CALIF.
60 EAST 42ND STREET, NEW YORK 17, N. Y.
341 KENNEDY BUILDING, TULSA, OKLA.





McLouth

HIGH QUALITY

Steel

We are now operating the first Oxygen Steel Process in the United States. This dramatic new method of refining is producing high quality steel with a low nitrogen content.

The advantages of the Oxygen Steel Process are another reason why McLouth high quality sheet and strip steels will serve you better in the product you make today and the product you plan for tomorrow.



McLOUTH STEEL CORPORATION

Detroit, Michigan

MANUFACTURERS OF STAINLESS AND CARBON STEELS

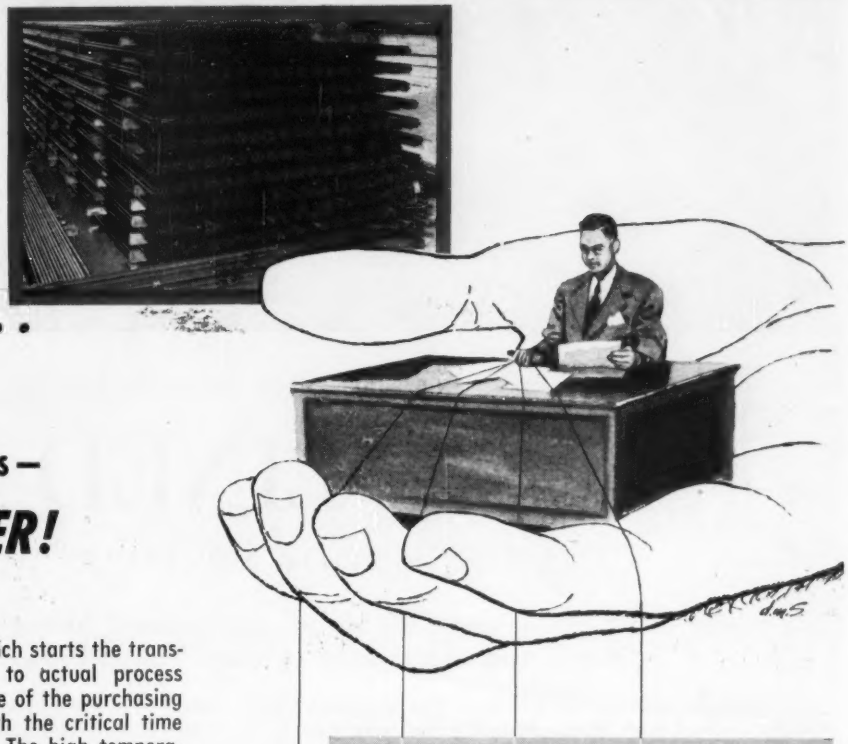
"THE BRAND OF PROGRESS"

By Heat Exchanger Specialists

▲ SYNOPSIS OF AD NO. 4: To provide the company's customers with a complete service in the design and construction of heat transfer equipment, Western Supply Company offers an experienced staff of thermal and mechanical engineers. This group works with the client's own engineering department to speed delivery and provide for maximum economy in labor and materials. A complete heat exchanger engineering service . . . at no additional cost to the customer.

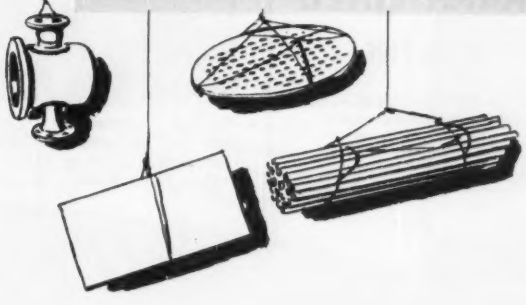
WESTERN'S Selective PURCHASING . . .

Builds better Heat Exchangers — *FASTER!*



Purchasing is the "bridge" which starts the transformation from paper plans to actual process equipment. And the importance of the purchasing function is linked directly with the critical time factors of equipment delivery. The high temperature, high pressure and corrosion problems of the modern chemical process industry frequently forces heat exchanger fabrication into an "emergency" catagory. The entire success of such a project may hinge on the purchasing department's ability to get special metals, parts, etc. into the plant on time. In Western's Tulsa warehouse, large inventories of rolled plate, tube-sheets and channel covers, steel and Admiralty tubes are maintained to guard against shortages on emergency orders. For hard to get or long procurement cycle materials Western keeps in close touch with local and out-of-state supply sources. Upon occasion, orders have been placed with these suppliers **in advance** of the customer's own purchase order to speed the work when the green light was given.

The process engineers at a large chemical plant recently discovered the beginnings of deterioration in Hexamine solution due to overheating. On Feb. 10th the company called Western . . . by Feb. 12th a 16", 10' fixed tube sheet exchanger had been designed . . . by Feb. 13th shell and tube side stainless steel parts had been located in the warehouse of a Tulsa metal company . . . EXCHANGER SHIPPED BY SPECIAL TRUCK FEBRUARY 25th — 15 DAYS FOLLOWING INITIAL INQUIRY.

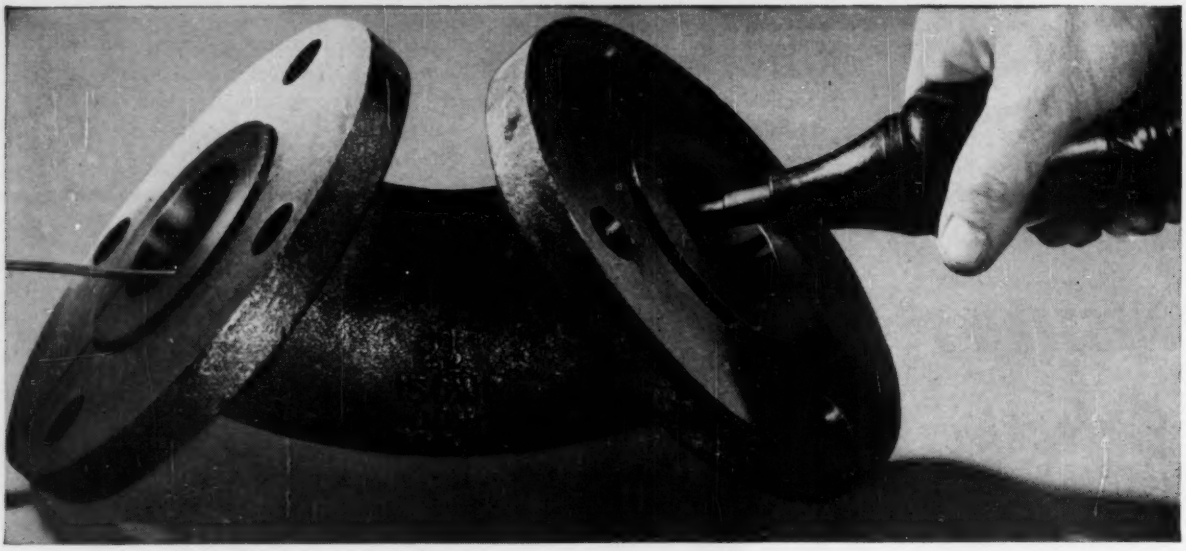


WESTERN HEAT EXCHANGERS

WESTERN SUPPLY COMPANY
P. O. BOX 1888 • TULSA, OKLAHOMA

HUDSON-RUSH COMPANY—753 Gladstone Blvd., Shreveport, La.
130 Casa Linda Plaza, Dallas 18, Texas
PROCESS INSTRUMENTS & EQUIP. CO.—North Bldg., Charleston, W. Va.
H. W. SEVERANCE—Marion E. Taylor Bldg., Louisville, Ky.

DOW



You can see why

SARAN LINED PIPE

KEEPS SHUTDOWNS TO A MINIMUM

It's made of corrosion-resistant saran pipe swaged into strong, rigid, nonbursting steel. And every piece is spark tested before you buy!

Unscheduled shutdowns are a thing of the past when you use saran lined pipe, fittings and valves to convey corrosive liquids. This modern, trouble-free piping is corrosion resistant . . . forms tight, snug, leakproof joints . . . won't burst under *working* pressures up to 150 psi. And every single piece of saran lined pipe is carefully spark tested by hand to be sure that there are no pinpoint holidays or cracks in its lining. Cast steel lined fittings are available for higher pressures.

Installation costs are surprisingly low with saran lined pipes, fittings and valves, too. They can be cut and threaded in the field with standard pipe-fitter's tools. Their rigidity means few supporting members are needed.

If you want to convey acids, alkalies, or other corrosive liquids at low over-all cost, be sure to investigate saran lined pipe. Contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Michigan, Department **SP528A-1.**

RELATED SARAN PRODUCTS

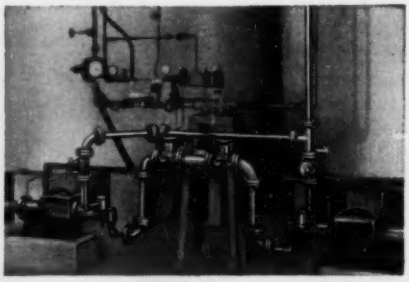
Tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY INSTALLATIONS USING

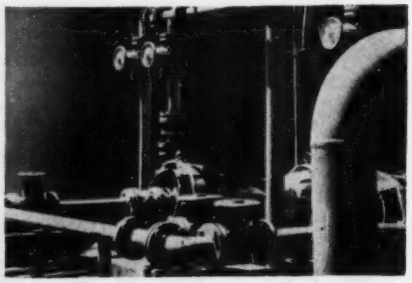
SARAN LINED

STEEL PIPE

Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan

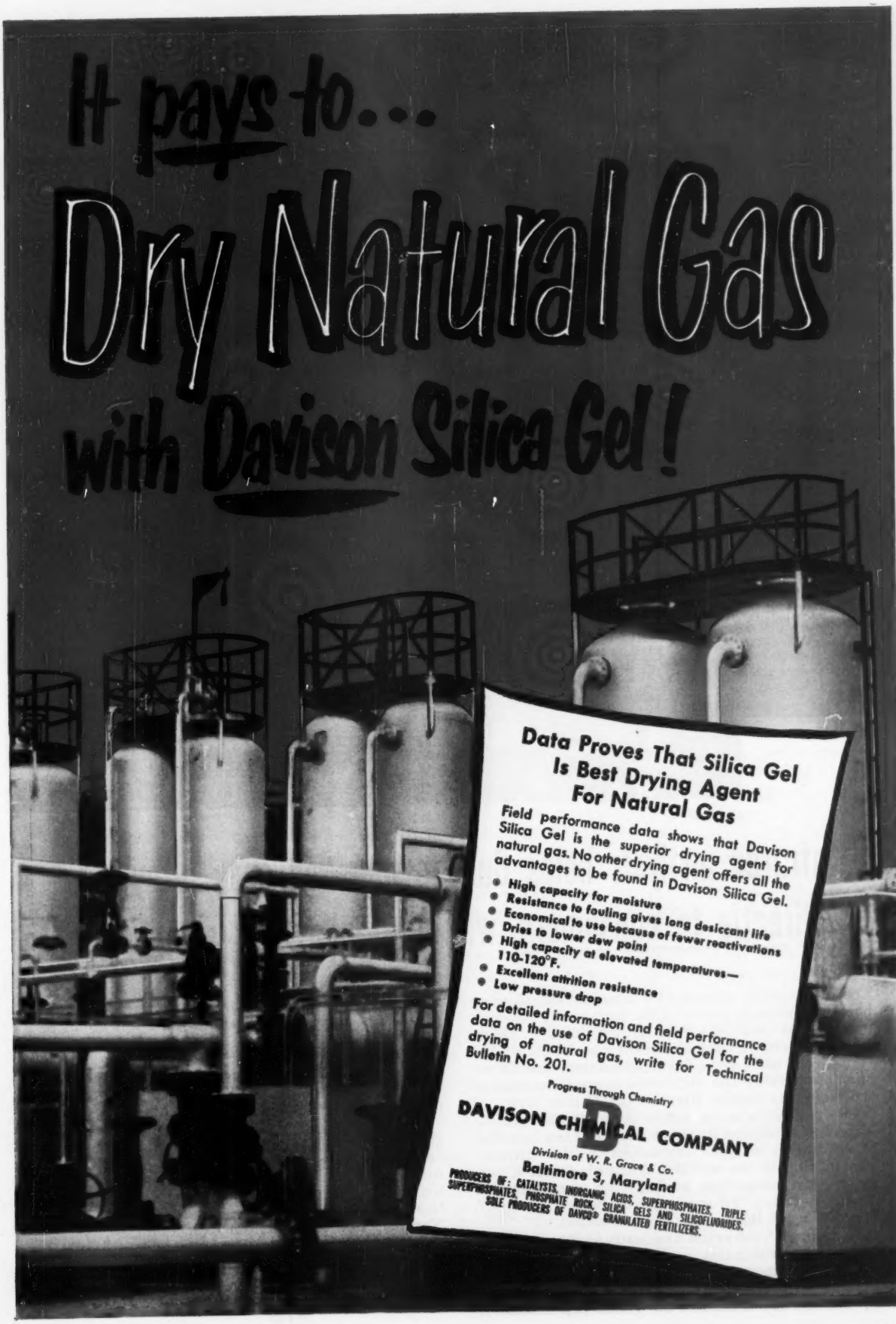


A large Southeastern paper mill uses saran lined pipe to handle corrosive alum solution. It has proved to be an exceptionally satisfactory answer to eliminating unscheduled shutdowns.



This installation of a large Midwest company has conveyed highly corrosive hydrochloric acid for over seven years. The joints have remained as tight and leakproof as new.

you can depend on DOW PLASTICS DOW


It pays to...
Dry Natural Gas
with Davison Silica Gel!
Data Proves That Silica Gel Is Best Drying Agent For Natural Gas
Field performance data shows that Davison Silica Gel is the superior drying agent for natural gas. No other drying agent offers all the advantages to be found in Davison Silica Gel.
High capacity for moisture
Resistance to fouling gives long desiccant life
Economical to use because of fewer reactivations
Dries to lower dew point
High capacity at elevated temperatures—110-120°F.
Excellent attrition resistance
Low pressure drop
For detailed information and field performance data on the use of Davison Silica Gel for the drying of natural gas, write for Technical Bulletin No. 201.
Progress Through Chemistry
DAVISON CHEMICAL COMPANY
Division of W. R. Grace & Co.
Baltimore 3, Maryland
PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, TRIPLE SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS AND SILICOFLUORIDES.
SOLE PRODUCERS OF DAVIGO® GRANULATED FERTILIZERS.



This electronic Speedomax instrument, calibrated in % ethane plus methane in ethylene, is panel-mounted in the Port Arthur control room to serve as recording teammate to the L&N Analyzer.

Infrared analysis helps Gulf to pipe "on spec" ethylene directly to consumers, without tankage or sampling

There's no costly storage—no laborious sampling or blending before shipment of the high-purity ethylene produced at Gulf Oil's Port Arthur Refinery. Operators are *certain* that the plant stream is always "on spec", as it runs from production directly to pipelines serving the ethylene-hungry industries of the Houston—Sabine River—Port Neches area.

One reason for such confidence in product quality is the L&N Infrared Analyzer that Gulf has installed to constantly monitor impurities in the ethylene stream. Should the sensitive Analyzer detect a predetermined percentage of impurity, operators can promptly divert "off spec" stream before "on spec" product in the lines can be contaminated.

Even though subjected constantly to the vibrations of a pipeline mounting, and electrical pick-up from pumps and compressors, the Analyzer checks consistently with daily spectrometer analyses—a tribute to the L&N instrument's all 'round dependability.

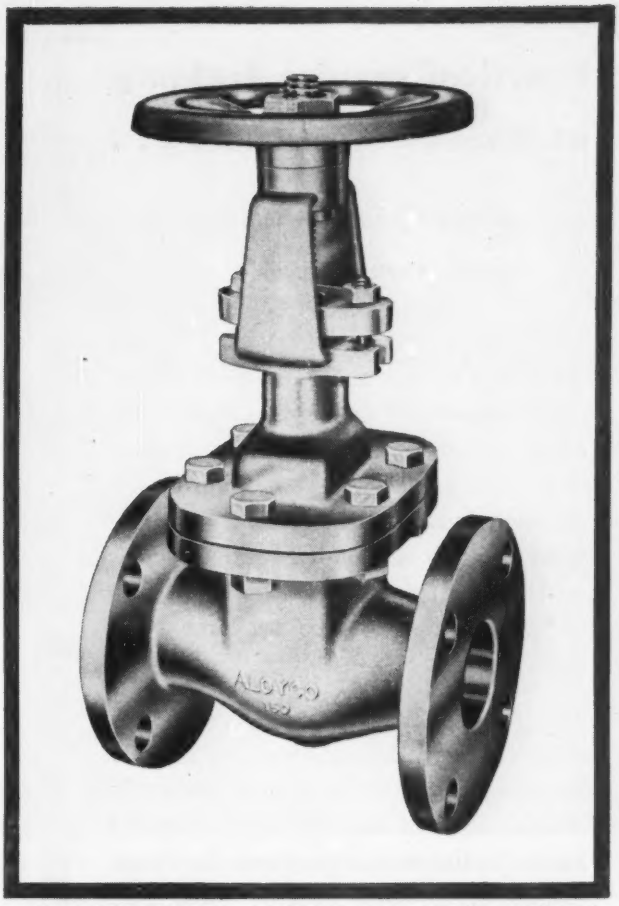
The Analyzer's prominent role at Port Arthur is duplicated in many other successful applications of this versatile instrument. It's measuring CO and CO_2 in the steel industry—SO_2 in H_2SO_4 stack gas—methane build-up in ammonia production—isobutane loss in petroleum. It may well be the yardstick *you* need in your own gas measurements.

Our Applications Lab is staffed with specialists glad to discuss your use of infrared. Outline your requirements, without obligation, in the Infrared Analysis Data Sheet we'll mail on request. Or, just write for our Demonstrator, "How the L&N Infrared Gas Analyzer Works." The address is Leeds & Northrup Co., 4916 Stenton Ave., Phila. 44, Pa.

LEEDS NORTHRUP
instruments *automatic controls • furnaces*

Are your valves over their heads in corrosive reducing solutions?

Switch to Aloyco Monel or Nickel Valves!



ALOYCO MONEL VALVES are used extensively in handling alkalies, salt waters, food products, organic substances, and many air-free acids.

Keeping corrosive solutions of mineral and organic acids, alkalies and salts under control is a job for Aloyco Monel or Nickel valves.

Monel valves are especially good for handling hydrofluoric acid which is used as a catalyst in one process for the production of high octane gasoline. Monel and Nickel have exceptional resistance to neutral and alkaline salt solutions, including chlorides, carbonates, sulfates, nitrates and others. Nickel is more resistant than Monel to more concentrated NaOH solutions at elevated temperatures and is usually preferred when contamination of the caustic with copper or iron would be objectionable.

Nickel, although similar to Monel in corrosion resistance, has generally an inferior resistance to acids, about the same resistance to salts and a little better resistance to alkalies.

Both alloys are available in a wide range of Aloyco valve designs. They're cast by induction melting at Aloyco foundries and machined in Aloyco plants. New bulletin #9, couponed below, provides complete information. Write today to ALLOY STEEL PRODUCTS CO., INC., Linden, N. J.

5.7



Alloy Steel Products Company, Inc.
1301 West Elizabeth Avenue
Linden, New Jersey

Gentlemen:

Please send me a free copy of your Bulletin No. 9 on Monel and Nickel valves.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

Practical service training at Honeywell's school . . .

makes your instrument men more valuable

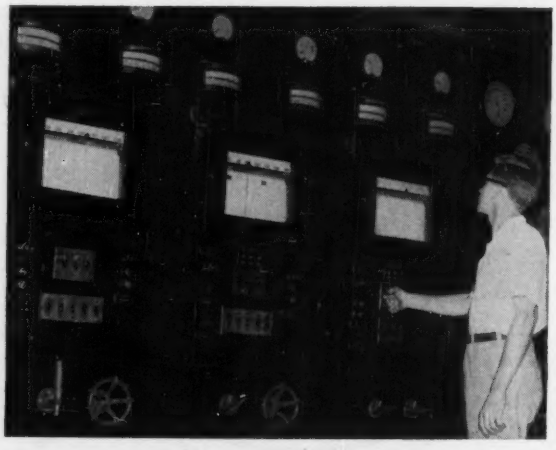
Your instrument maintenance men can get a real education in the most up-to-date methods for servicing instruments, at Honeywell's Training School. Any organization which uses Honeywell instruments can send maintenance personnel to this school. Tuition costs you nothing, for this school is maintained as a "plus-value" service to Honeywell customers.

Thousands of technicians have either started or augmented their instrument knowledge here. A variety of courses is available, to fit men for the particular kind of maintenance problems they may encounter in their specific jobs. The comprehensive course . . . one of the most complete and intensive offered anywhere . . . covers about thirteen weeks. Other courses cover five weeks and less, to offer condensed instruction of either a basic or "refresher" nature to men who can't be spared for extended periods.

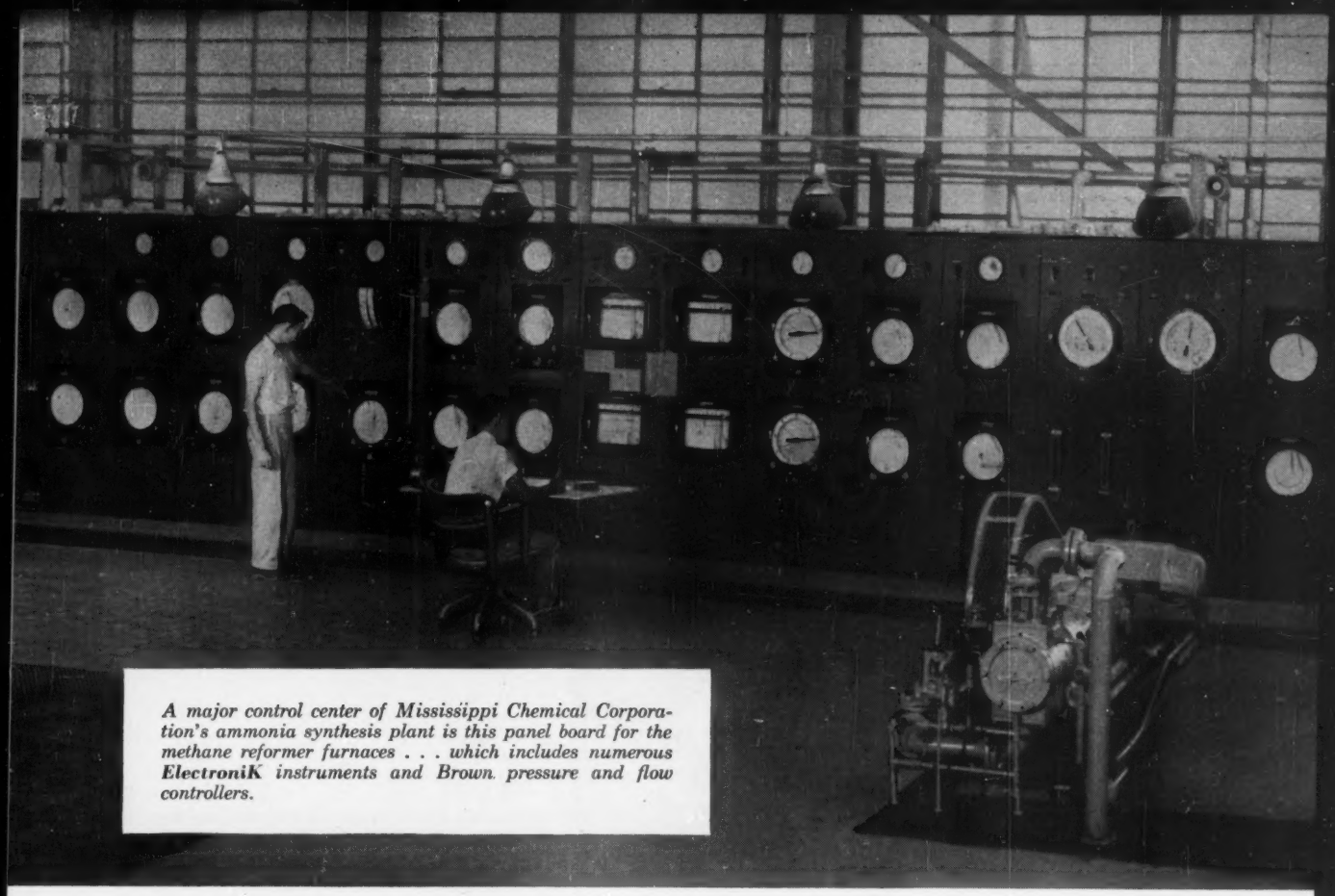
There's nothing academic about this school. The emphasis is placed on practical knowledge. Theory through lectures and textbook study is liberally supplemented by laboratory sessions and actual bench work on all types of instruments and related equipment.

One caution: classes have to be limited to assure thorough attention to all students, so make reservations in advance. Your local Honeywell office will be glad to make arrangements. Call today . . . it's as near as your phone.

Coordinated control helps reduce cost of



Ammonia synthesis converters are controlled from this panel, on which are multi-point ***ElectroniK*** *temperature recorders and (near top)* ***Pyr-O-Vane*** *millivoltmeter indicators.*



A major control center of Mississippi Chemical Corporation's ammonia synthesis plant is this panel board for the methane reformer furnaces . . . which includes numerous ***ElectroniK*** *instruments and Brown pressure and flow controllers.*

high pressure ammonia plant

THE Claude process ammonia synthesis plant of Mississippi Chemical Corporation, at Yazoo City, Miss., was built at a substantial saving in initial cost . . . through the elimination of intermediate storage and surge tanks. Raw materials go through the process in a continuous stream.

To achieve this, every phase of processing must be held in precise coordination. Thorough, automatic control is the answer. Furthermore, the control system has to do its job accurately and unfailingly, for any deviations from desired conditions would be magnified throughout the process. To achieve these objectives, Brown recorders and controllers were selected for many assignments.

The variety of applications demonstrates the broad scope which this line of instrumentation covers . . . including temperature, pressure, flow, liquid level, gas composition. On the critical high pressure synthesis reaction, for example, a multi-point *ElectroniK* instrument records six selected temperatures. In addition, Brown millivoltmeter pyrometers provide continuous indication of each, to guide operators during start-up and emergencies. Purge gas pressure and flow are recorded on two-pen instruments. Similarly, the carbon monoxide converters, carbon dioxide absorbers and other units are fully equipped with essential measurement and control systems.

By turning to a single source of control instrumentation for so many varied types of systems, any plant can enjoy the advantages of unified responsibility . . . simplified training of operating and maintenance personnel . . . and assurance of coordinated engineering of equipment that must function harmoniously for maximum overall efficiency.

Ask your local Honeywell sales engineer to discuss ways that your own process control requirements can profit by this broad line of instrumentation. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

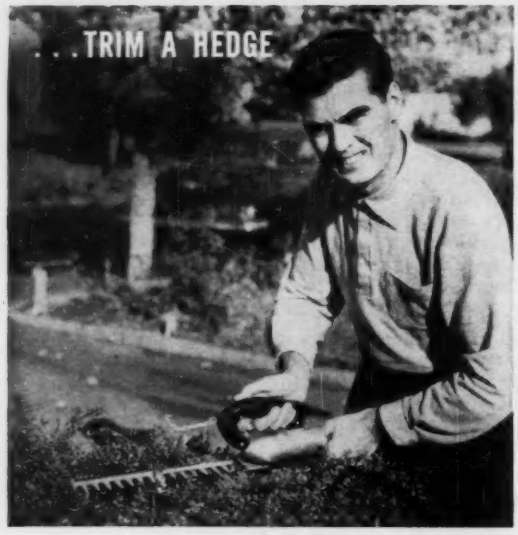
● **REFERENCE DATA:** Write for Composite Catalog No. 5002 for a condensed description of the complete Honeywell line.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



HOW HERCULES HELPS...

HERCULES CELLULOSE CHEMICALS, made to the exacting specifications of Polaroid, are keys to the remarkable Land process which provides finished photo prints sixty seconds after a picture is taken.



LIGHT WEIGHT AND FAST CUTTING, this electric clipper trims hedges, trees and shrubs in minutes instead of hours. Its strong, comfortable-feeling handle is made of Hercules Hercocel®—a flame-resistant acetate.



TAKE IT OR LEAVE IT: One man, riding a lift truck, easily handles one ton of Hercules PE in this optional, unitized loading. Product itself is made to high degree of uniformity, under continuous automatic control, and is shipped under rigid particle specifications which assure maximum efficiency during chemical reactions.

HERCULES

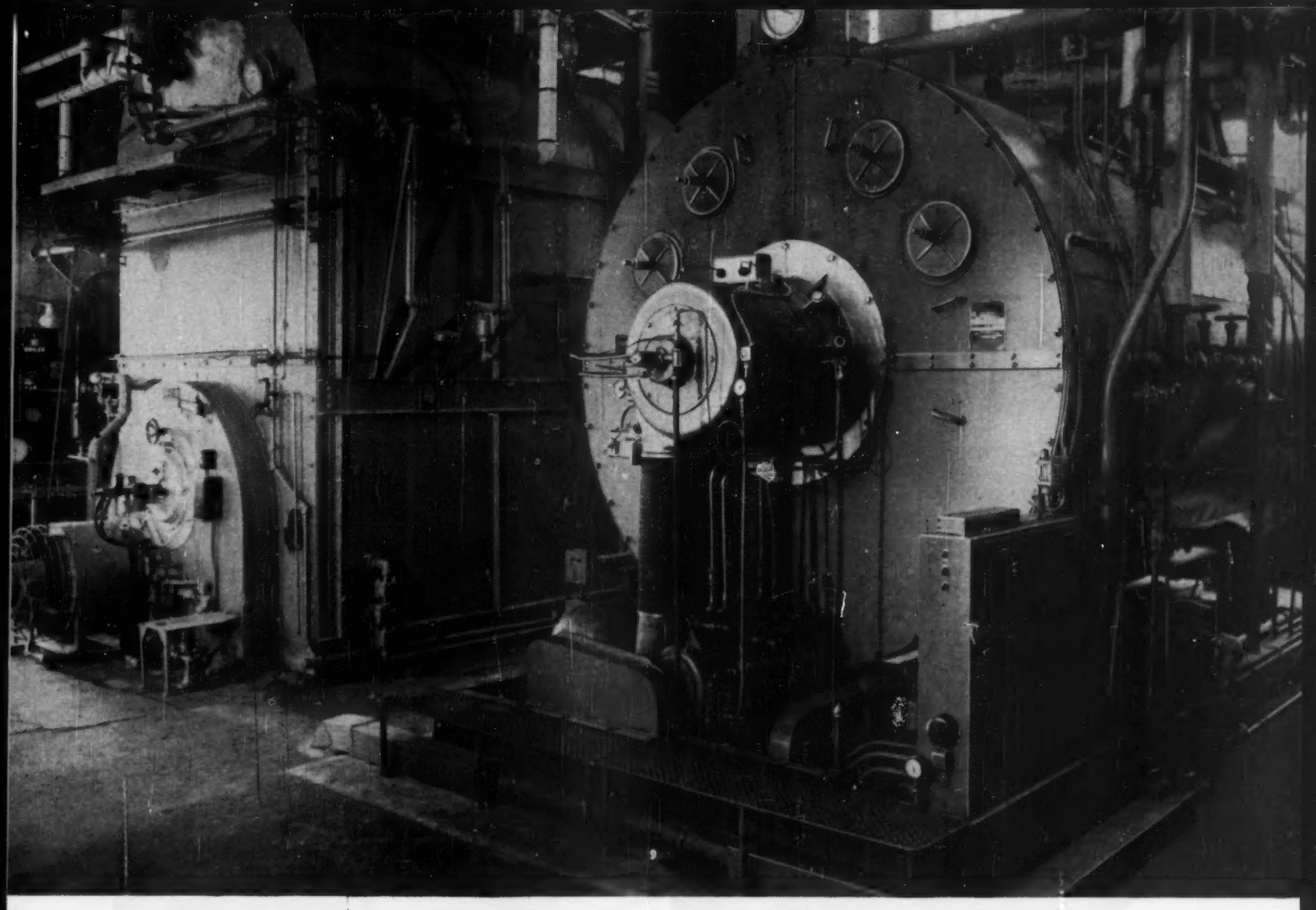
CHEMICAL MATERIALS FOR INDUSTRY

HERCULES POWDER COMPANY
INCORPORATED

952 Market St., Wilmington 99, Del. Sales Offices in Principal Cities

SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS

G55-6



Why was this *Powermaster*® switched from "Stand-by" to Full-Time Duty?

You get MORE than fuel economy with Powermaster

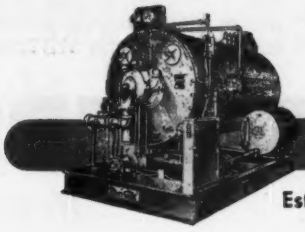
- ★ Low-cost, space-saving installation
- ★ Fast steaming
- ★ Instant response to load changes
- ★ Quick fuel change-overs
- ★ Clean, dry steam
- ★ Automatic operating and safety controls
- ★ Clean, quiet operation
- ★ Smokeless combustion
- ★ One-source responsibility for complete unit
- ★ Nation-wide factory-trained service organization
- ★ Pay-As-You-SAVE Purchase Plan

Originally purchased as a stand-by unit to supplement two older water-tube boilers, this 500 HP heavy oil *Powermaster* Packaged Automatic Boiler was quickly put on full-time duty by an Eastern rubber goods company.

The reason is *Powermaster's* fuel economy. While the *Powermaster* now carries the plant load continuously, the older boilers, one of which is shown at left above, are operated only when necessary.

Powermaster's cost-cutting and worry-saving advantages can be yours quickly and easily under Orr & Sembower's new Pay-As-You-SAVE Purchase Plan.

Write for Bulletin 1220.



Powermaster®

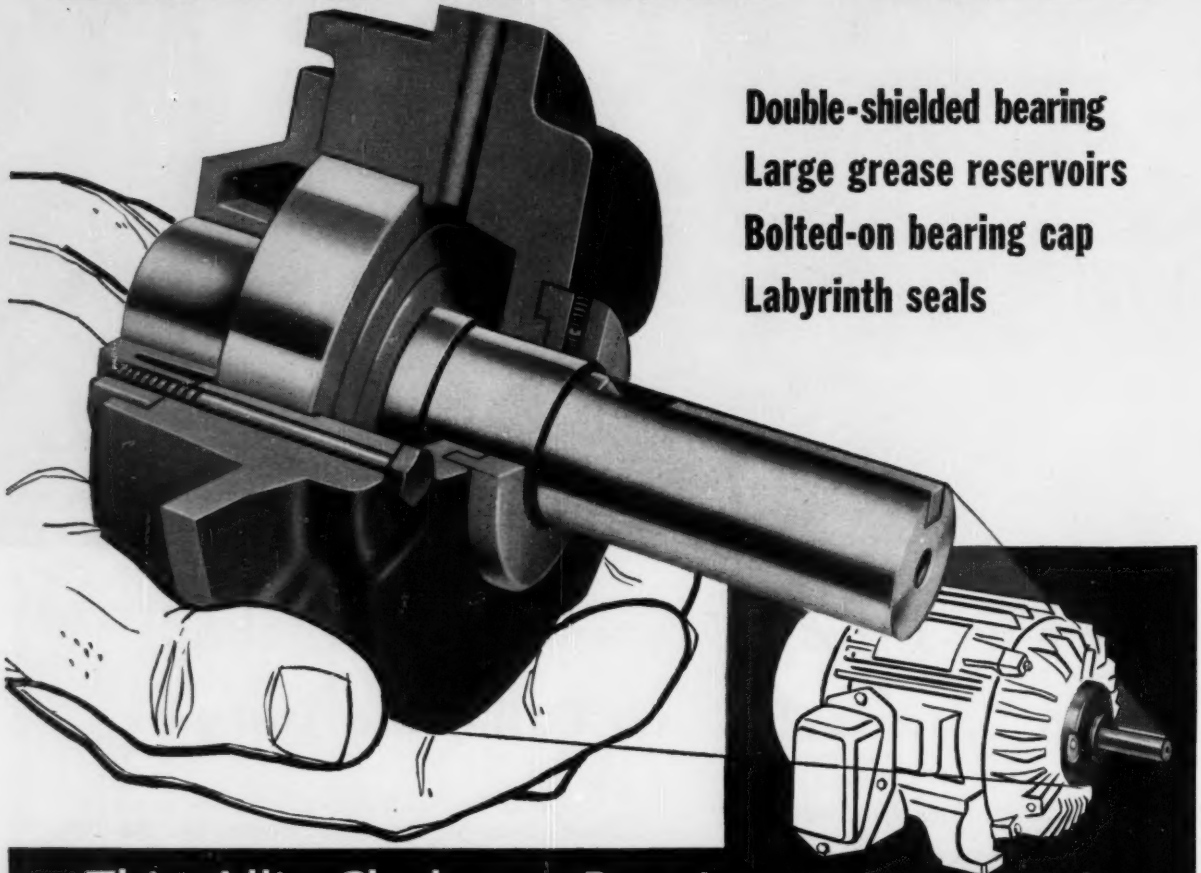
PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.

ORR & SEMBOWER, INC.

Established 1885 • Morgantown Road, Reading, Pa.

Here Is Extra Motor Value



Double-shielded bearing
Large grease reservoirs
Bolted-on bearing cap
Labyrinth seals

This Allis-Chalmers Bearing Design Gives More for Your Motor Dollar

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

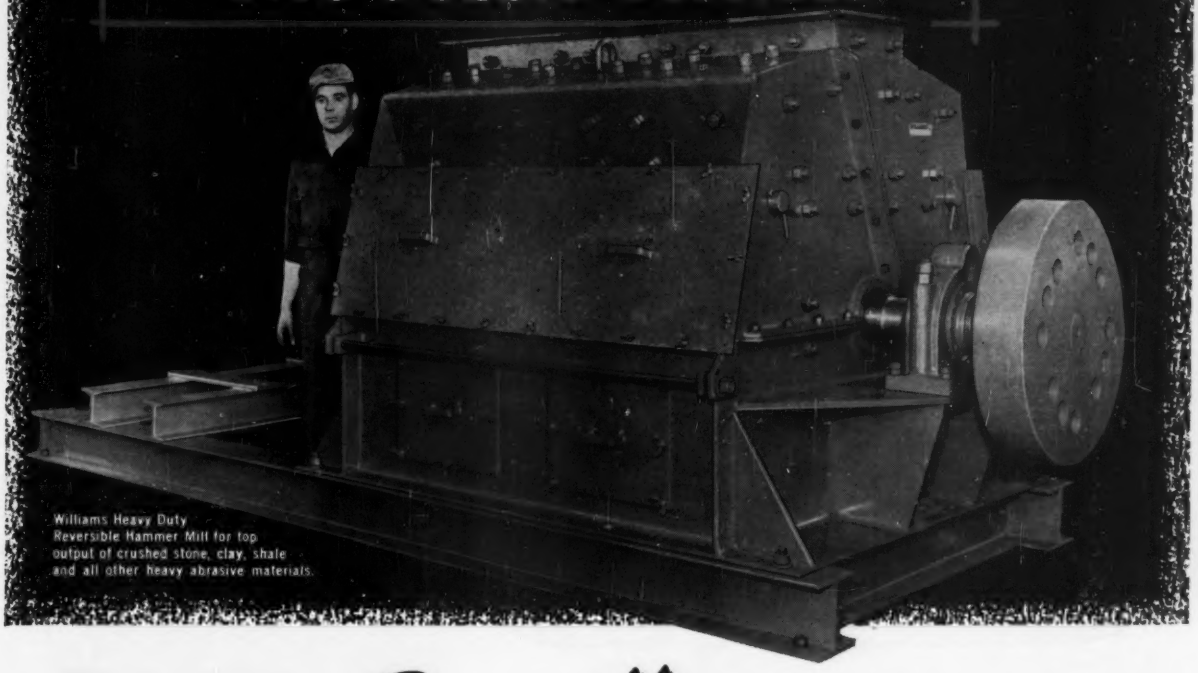
You can lubricate these bearings without dismantling motor. Pipe-tapped holes in the bearing housings at two points provide means for inserting new grease, flushing out old grease and of relieving pressure during re-greasing.

Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7225.

A-4616

ALLIS-CHALMERS

These Crushing Machines Give Double Service!



Williams Heavy Duty Reversible Hammer Mill for top output of crushed stone, clay, shale and all other heavy abrasive materials.

WILLIAMS *Reversible* HAMMER MILLS

Double service from hammers, breaker plates and grate bars—maintenance reduced to half or less—downtime cut as much as 50%—these are only a few of the money-making, time-saving features of Williams Reversible Hammer Mills.

Operation either clockwise or counter-clockwise with a reversible motor promises that hammers and other internal parts will work twice as long without even opening the machine. Slower and more even wear results in continuous peak output of a uniformly high quality product while, at the same time, demanding the very minimum of time and expense in the replacement of worn parts.

Reversible manganese breaker plates also give twice the usual length of service, and are adjustable to compensate for hammer wear to maintain original close settings.

For the most in real operating economy, high production and top quality products, get the facts about Williams Reversible Hammer Mills. *Write For Catalog.*



Open view of Reversible Hammer Mill. Note heavy shock-proof, wear-resistant manganese steel liners and breaker plates, and the rugged, reinforced construction. Entire interior easily, quickly accessible. Rotor removable without disturbing feeder or feed chute.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. Ninth St. St. Louis 6, Mo.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS



Impactors Helix-Seal Mills Roller Mills Air Separators Vibrating Screens Feeders

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



stainless steels are thoroughbred, too

The experienced exhibitor rents extra stalls... leaves them empty... to prevent contamination of his thoroughbred pets by canine neighbors.

To develop their best qualities demands *exclusive* care. That is why Sun Ship's new Alloy Products Shop has been planned for the *exclusive* fabrication of stainless and alloy steel products. When you have selected from the many available Alloys a stainless steel best suited for your service condition, you have done only half the job. You must also provide for the best possible fabrication if you are to have full protection—"A Thoroughbred Job."

Why entrust stainless steel to be fabricated in the same shop where carbon steel products are fabricated, and subject this precious metal to contamination with iron fragments, dust, or other harmful elements? A segregated shop is your answer.

Sun Ship now operates an all-alloy shop, one especially built and equipped for fabricating stainless and alloy products as they should be—segregated from carbon steel fabrication.

We emphasize the fabrication of medium and heavy stainless, alloy and aluminum products for industry.

Try Sun Ship for stainless fabrication as it should be done.

Our Sales Engineering Department will be pleased to assist you with any of your fabrication problems.

Sun Ship also makes all types of carbon steel pressure vessels.

ALLOY PRODUCTS SHOP

OF Sun SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • **CHESTER, PA.** • 25 BROADWAY, NEW YORK CITY

write for



your free copy

This 24-page booklet alphabetically lists the many chemicals available from Harshaw. Read the story about Harshaw's growth since its beginning in 1897. Pictures of plants, warehouses, research and manufacturing operations are scattered throughout the book. We will gladly send you a copy if you write.

THE HARSHAW CHEMICAL CO.
CLEVELAND 6, OHIO
Chicago • Cincinnati • Cleveland • Detroit • Houston • Los Angeles
New York • Philadelphia • Pittsburgh

THE HARSHAW CHEMICAL CO.
CLEVELAND 6, OHIO

I would like a copy of your free booklet "An Alphabetical List of Harshaw Industrial Chemicals."

MY NAME _____

COMPANY NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



Unretouched View of an Irrigated Tower Section Photographed [illegible] Tower.

The surface area of the packing in a column that is in contact with both liquid and gas is the only surface area that counts. Packings that "nest" or "pattern pack" have a low ratio of effective area to actual area. Pressure drops rise, flooding limits lower.

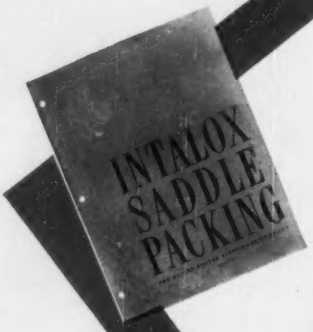
Examine the photograph above. There is no blocking of surface area there. The unique design of Intalox makes certain that no two pieces of Intalox can nest or cover each other to such an extent that any significant portion of the packing surface is rendered ineffective.

This greater randomness in a packed bed means better packing performance — greater tower efficiency at lower cost.

U. S. STONEWARE

Akron 9, Ohio

WRITE FOR THIS NEW 16-PAGE BOOKLET ON INTALOX SADDLE PACKING



This new booklet (Bulletin S-29) gives detailed comparative data on the relative efficiencies of various packings — shows how Intalox Saddles can help you reduce tower heights, lower gas pumping costs, or obtain greater capacity from your present tower. Free on request. Write

THE U.S. STONEWARE CO.
Akron, Ohio

358D-1

TYPICAL DATA ON INTALOX* SADDLE PACKING

Nominal Size, Inch	Approximate Number per Cu. Ft.	Approximate Weight per Cu. Ft., Lb.	Approximate Surface Area Sq. Ft./Cu. Ft.	Percent Free Gas Space	Equivalent Spherical Diameter Dp, Inch
¼	117500	45	300	75	0.20
½	20700	41	190	78	0.32
¾	6500	40	102	77	0.48
1	2385	38	78	77.5	0.68
1½	709	35	59.5	81	0.96
2	265	38	36	79	1.38

**Trade name, The U. S. Stoneware Co.*

JULY 1955

Chementator

Edward T. Thompson

● At least 10 firms want to license a new process to make colorless nonionic detergents and emulsifiers from sugar and tallow. Developed by Foster D. Snell, Inc., details will be revealed this fall by the Sugar Research Foundation, sponsor of the work.

● A simple way to make essentially nonhygroscopic complete fertilizer has been devised by Cannac Research and Development, New York. Nitric acid digests phosphate rock, KCl is added to take out fluorine and product is precipitated by neutralizing with ammonia.

Big switch in hydrocarbon synthesis

Important new horizons in the synthesis of hydrocarbons from carbon monoxide may be close. Going beyond its own liquid-phase Fischer-Tropsch processes, Rheinpreussen AG in Germany has developed a direct, liquid-phase process to convert CO with water vapor in a single pass. Capital costs, even for a small plant, are estimated to be only about one-third those of a Fischer-Tropsch plant, prime products costs about 60% because gas making and purification, water gas shift reaction and recycling steps are eliminated.

Details of the latest progress were brought out in June at the Fourth World Petroleum Congress in Rome where it was predicted that the biggest use would probably be with byproduct, CO-lean charge stocks such as blast furnace gas. Such gases have only fuel value and at peak production levels, sometimes not even that.

Basic to the whole development was the discovery that operations are limited to between 1 and 2 parts of water vapor per 3 parts of CO. Excess CO brings heavy carbon deposits; excess water inactivates the iron catalyst by oxidation. In large-scale tests at a water-CO ratio of 1.15 to 3, Rheinpreussen achieved 93% CO conversion in one pass. Yield was 0.0125 lb./cu.ft. of CO—70-80% olefins and nearly 90% C_3 and heavier.

Reaction mechanism isn't fully understood. At first it was thought it might be a water gas reaction followed by Fischer-Tropsch synthesis. When this sequence was artificially induced, however, yields were much lower than with the new process. But whatever the mechanism, Rheinpreussen feels it has tapped a new source of hydrocarbons—mostly for petroleum products in Germany, but possibly for chemicals in oil-rich countries like the U. S.

Is there a shortage of engineers?

Not nearly as much as we've been given to believe. At least that's the interpretation some experts are putting on a recent Bureau of Labor Statistics survey that will be the basis of a major manpower report this summer.

Here's what these experts have concluded: Reports of general engineer-scientist shortages are exaggerated. The only real shortages—at least in research and development, maybe in all industry—are for people with lots of experience in very narrow specialties, mostly in aircraft and electronics. There is no lack of young scientists fresh from college.

These views, coming amidst a crescendo of reports and opinions to the contrary, are sure to stir up controversy. They are based on the reports of 200 firms that account for the bulk of industrial R&D, about half of whom say frankly that they're unaffected by manpower problems.

One group that will particularly welcome the

Chementator ® contents copyright under the general copyright on the July 1955 issue—Chemical Engineering, 330 W. 42nd St., New York 36, N. Y.

survey is the military, which, generally, has been fighting the idea that "because they're in short supply, draft-age scientists should get special treatment." However, it seems unlikely that the survey's general indication of "no shortage" will be applicable to all types of scientists. Just how chemical engineers and chemists fit into the picture won't be known until the document is officially issued.

More on low-pressure polyethylene

It looks suspiciously like there may be another low-pressure polyethylene process coming along to compete with the Ziegler and Phillips processes (Chementator, April and May 1955). This one is being developed by Standard Oil of Indiana, which already has at least eight U. S. patents covering various low-pressure routes.

Standard officials decline to comment on what commercial polyethylene plans they may have, but do admit to still working on the process. And since they've been active for over seven years and have obviously spent a lot of time and money on research, they must have more than an academic interest.

As usual with patents, it's impossible to simply read these and tell which of Standard's several routes is most likely to be commercially feasible. But certain features are common to almost all: Operating pressure needed is about 1,000 psig.; temperature is 450-550 F. Probable catalyst is a subhexavalent molybdenum oxide.

Not much is said about the physical properties of the polyethylenes made except that they can be grease-like, wax-like or tough, resinous solids. The last, of course, are the most interesting today. These have molecular weights ranging from about 30,000 to 250,000 and even much higher.

Where Standard's going from here with its processes is still anybody's guess. But don't be surprised to hear a lot more from this company soon on polyethylene.

Humble Oil may go into sulfur

About 7½ miles off the Louisiana coast and down 1,700-2,000 ft. lies what may be the world's biggest sulfur dome, covering several hundred acres. Over a year of core drilling has convinced Humble Oil & Refining that development of this dome—Grand Isle Block 18—may be economical despite the many difficulties expected in drilling so far off shore.

The big question now is who will do the developing. Rumors are flying that Humble may do its own mining. On the other hand, all the sulfur companies have been invited to inspect the huge deposit and some have evinced considerable interest. (Some confusion was introduced recently with the formation of Humble Sulfur Co. in Houston. It has no connection with Humble Oil and is not known to be interested in the Grand Isle deposit.)

Trouble is, nobody has any experience in such deep-water sulfur mining.

Two problems are paramount: how to get large quantities of hot water to the site and how to get molten sulfur back to land. One idea on the first is an insulated pipe to carry either hot fresh water from the Mississippi River or hot brackish water from nearby bayous. (Freeport Sulphur has done a lot of work on use of brackish water in sulfur mining.) Another possibility is to heat cold water from the mainland at the well.

Costs, of course, are still a major unknown. One estimate is that a well might cost $100,000, compared with $10-15,000 for an inland well. Humble is more optimistic, figures plant and production costs might be 2-3 times those of comparable inland mines at larger deposits. And the firm believes that a big enough offshore mine with favorable mining characteristics probably could be competitive with inland mines at today's sulfur prices.

High-grade coke from new source

American Gilsonite Co. has decided to build a $10 million project to convert gilsonite, a highly resinous asphaltite, to coke—for electrodes and specialty carbons—and top quality gasoline. An 80-mile pipeline (capacity, 600-700 tons a day) will run from the firm's mine at Bonanza, Utah, to a new coking plant in western Colorado that's scheduled to start up late next year.

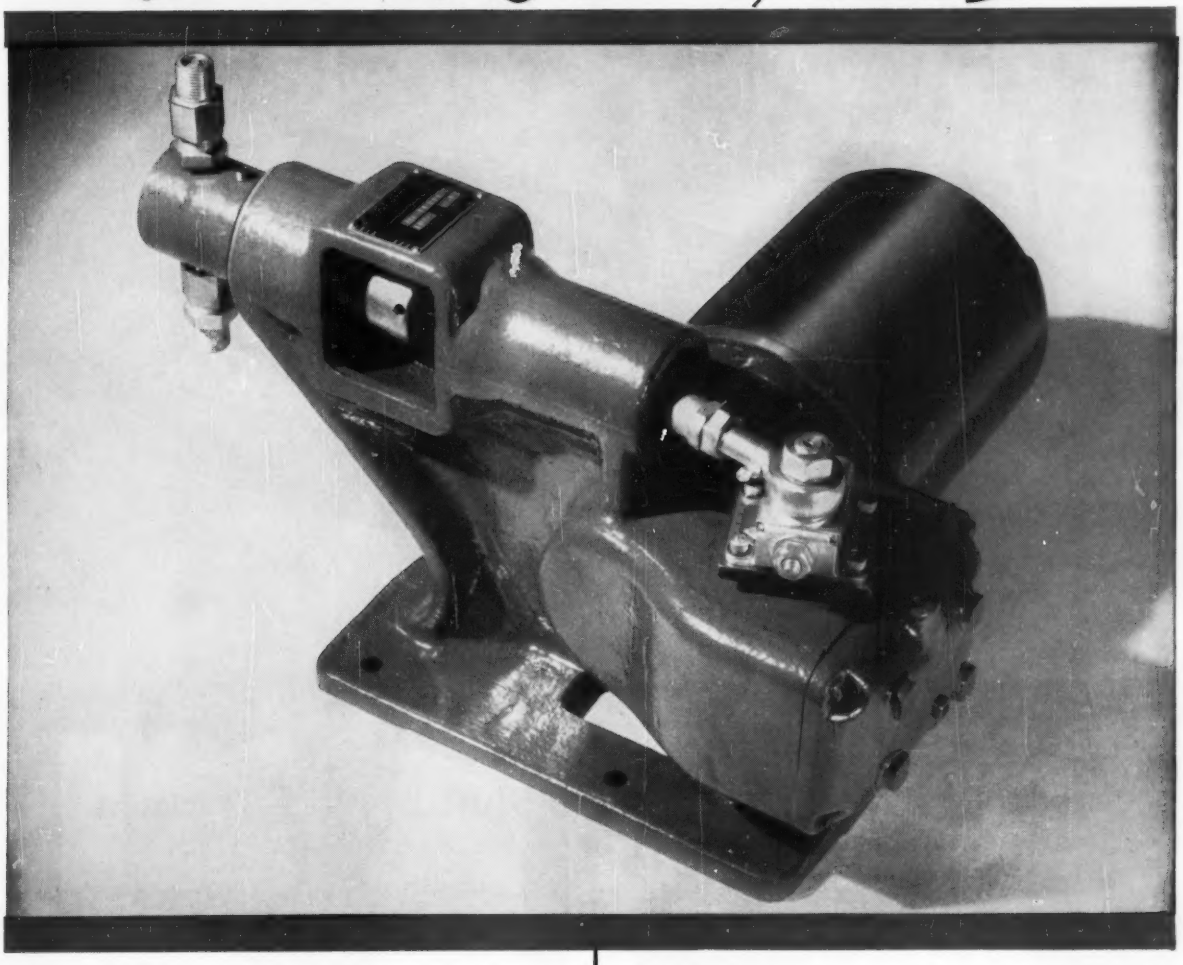
A new hydraulic mining technique will be used to supply necessary tonnage economically. Then, before introduction into the pipeline, gilsonite will be stored in an agitated water suspension of about 35% solids. At the plant, water will be dropped out in two stages—passing first through a series of centrifugal screens, then through a unique filter that will finish dewatering and drying the gilsonite.

Dry gilsonite will then be melted in the bottoms stream from a catalytic reformer and fed to a delayed coker. Coker overhead will go back to the reformer. End products will be 40% high-grade, low-sulphur coke, 45% 93 octane gasoline and 15% gas that initially will be used as fuel. Evaluation of the coke by aluminum companies indicates that

(Continued on page 108)

Look!





NEW CHEMICAL PROPORTIONING PUMP

More pump for less money!!! Write for prices, capacities, and specifications on the new Proportioneers Model 1105-KH. Proportioneers, Inc., 369 Harris Ave., Providence 1, Rhode Island.

PROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.

B·I·F METERS FEEDERS CONTROLS

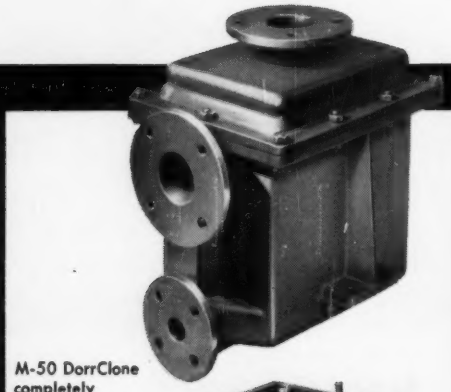
TECHNICAL SERVICE REPRESENTATIVES IN PRINCIPAL CITIES OF THE UNITED STATES, CANADA, MEXICO AND OTHER FOREIGN COUNTRIES

New!

THE TYPE M DorrClone



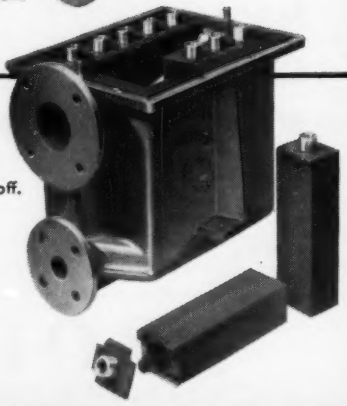
M-30 DorrClone completely assembled.



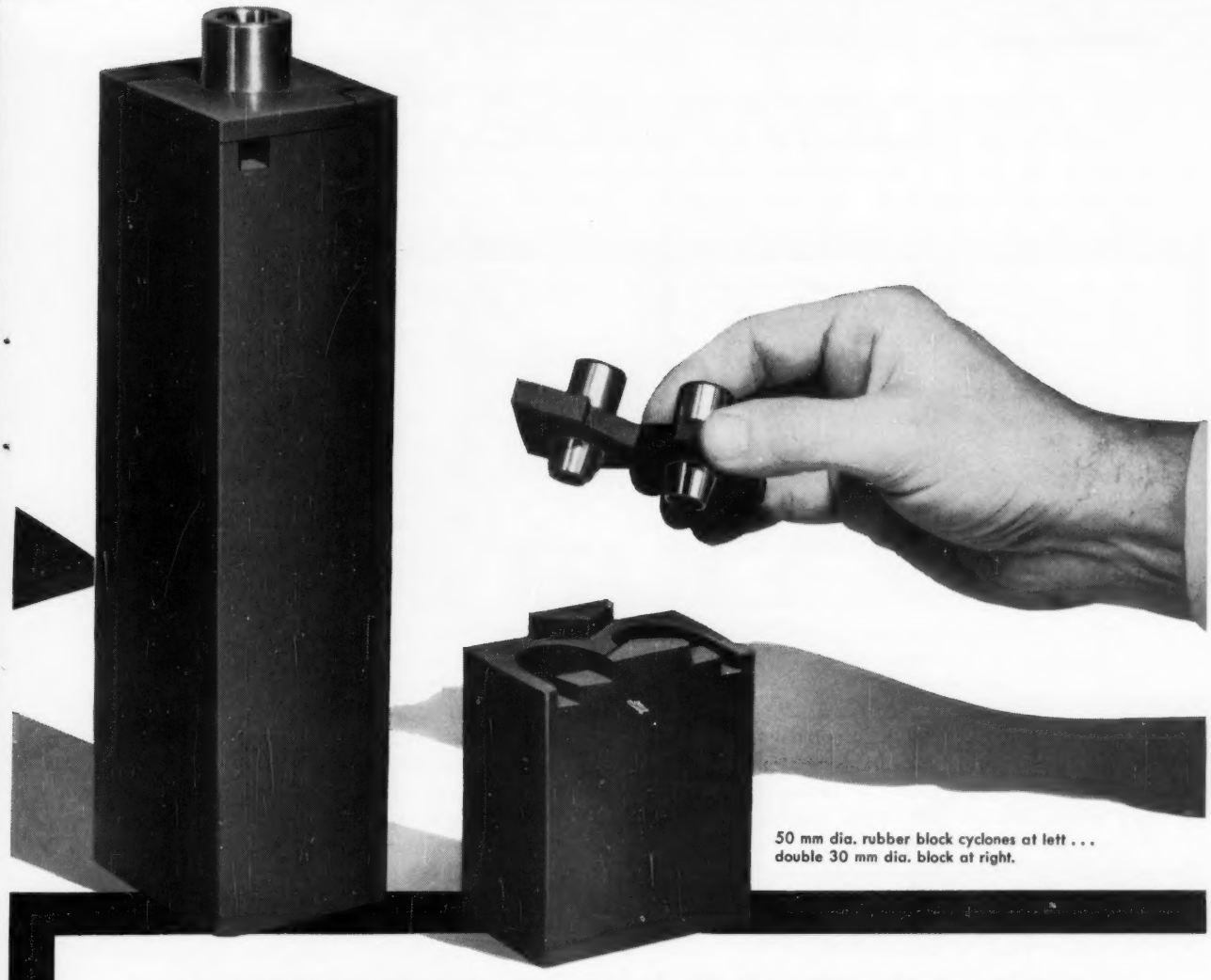
M-50 DorrClone completely assembled.



M-30 DorrClone cover plate off.



M-50 DorrClone cover plate off.



50 mm dia. rubber block cyclones at left . . . double 30 mm dia. block at right.

Multiple Molded Rubber Block Cyclones Make Sharp Separations in 10-20 Micron Range . . .

Latest advance in wet cyclone design is the Type M DorrClone . . . developed for size separations in the 10 to 20 micron range. Designated as M-30 and M-50, this new design is now available with twenty 30 mm dia. rubber block cyclones or ten 50 mm cyclones in a common housing. Housings may be either cast stainless steel or bronze construction. When cover plate is bolted in place, each block is under compression to form a tight seal between feed, overflow and underflow chambers.

As with all cyclones, capacity and mesh of separation in the M DorrClone varies with the diameter of the individual units, operating pressure, feed solids concentration and specific gravity of the solids. On a slurry with a solids specific gravity of 2.7, the M-30 separates at 8-10 microns and the M-50 at 15-20 microns. As to capacity, the M-30 handles approximately 70 gpm at 20 psi, 100 gpm at 40 psi and 125 gpm at 60 psi. At these pressures the M-50 handles approximately 100 gpm, 140 gpm and 170 gpm. Top operating pressure for both is 125 psi.

For more information on this newest classification tool write for a copy of Bulletin No. 2504. Dorr-Oliver Incorporated, Stamford, Conn.

Lab units also available . . . for test units or very low flows. Fabricate stainless steel housing contains four 30 mm units or two 50 mm units. Separations are the same with equal diameter cyclones. Write for quotation.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

it has several advantages besides extremely low sulfur content.

Gilsonite has been dry-mined by American Gilsonite for use as an insulator since 1950 and has been used much longer for such things as floor tiles (25% of all gilsonite mined in the U. S.), chemical tank linings, anticorrosion paints and marine cable wrappings. It's also been added to crude oil to up output of high-grade heavy fuel oil (*Chem. Eng.*, June 1952, p. 254).

But total production for these uses has never topped 80,000 tons a year. The new plant alone will account for more than double that.

Alumina plant sale finally final

No more in-fighting is expected over sale of the government's $4.5 million alumina-from-clay plant at Laramie, Wyo. Following an unexpected second round of bidding, the General Services Administration has accepted a bid of $1,373,000 cash from Ideal Cement Co. of Denver. The loser: Monolith Midwest Portland Cement Co.—again.

GSA had presumably accepted an Ideal bid of $1.2 million last March. But Monolith complained bitterly that Ideal had been allowed to up its bid over the Monolith offer and that Monolith had no such chance. GSA maintained that Monolith had said it wouldn't raise its bid.

So the hassle was taken up by Rep. Brooks (D-Tex.) and his subcommittee on government activities. They recommended that GSA reopen the bidding for a few days. At first GSA refused, but later decided to go along with the idea. In the last round Ideal came up with three proposals: $1,373,000 cash; or $1.25 million on terms; or $10,000 more than any other legal bid up to $1.55 million. Monolith offered only $1.3 million on terms.

Ideal will use the plant to make lightweight aggregate for its cement operations, has no plans to work on alumina. However, the firm has agreed to keep the alumina facilities intact for 10 years so the government can recover them at any time following a fair notice and purchase price.

For Hercules: Expansion by oxidation

High on the list of possible Hercules Powder expansions is the idea of building a major plant at Gibbstown, N. J., to make *p*-cresol, maybe as much as 4 million lb./yr. If it materializes it will mark the second product to be made commercially by the Hercules-Distillers Co. cumene-type oxidation-cleavage process. And it could well presage a slew of other important applications of the new technique.

First use of the process has been to make phenol and acetone from cumene—by Hercules at Gibbstown, B. A. Shawinigan at Montreal and Standard Oil of California at Richmond, Calif. But for Hercules, phenol is just the start. Besides *p*-cresol, which is now made semicommercially (nearly a million lb./yr.) at Hattiesburg, Miss., the firm is also looking hard at production of resorcinol, hydroquinone and dicumyl peroxide by the same basic process.

Raw material for *p*-cresol is *p*-cymene, made by catalytic dehydrogenation of monocyclic terpenes, such as dipentene, terpinene and terpinolene. Dehydrogenation coproduct *p*-menthane is separated out by fractionation. It's important, too, that monocyclic terpenes can be made from dicyclics like terpentine. This will give Hercules potential new outlets for many of its naval stores.

Cymene is air-oxidized as in the phenol-from-cumene process to *p*-cymene hydroperoxide—20-30% conversion per pass. This is then cleaved with sulfuric acid catalyst, yielding mostly *p*-cresol and acetone in a wt. ratio of 2.5:1. Byproducts are cumic acid and isopropyl phenol. Major outlets for *p*-cresol now are in antioxidants, dyes and production of essential oils. All these are growing.

Plans for resorcinol and hydroquinone (made from di-isopropyl benzene) and dicumyl peroxide (from cumene hydroperoxide) are not so advanced, but prospects are excellent.

The latter, which is in semicommercial production, is particularly attractive because, says Hercules, it can be used to vulcanize rubber, replacing not only the sulfur but the accelerators and activators required by sulfur vulcanization. At its present price of $1.10/lb., the peroxide costs more to use than sulfur systems. But as volume increases, Hercules is confident that price will certainly drop far enough to put the product in a favorable competitive position.

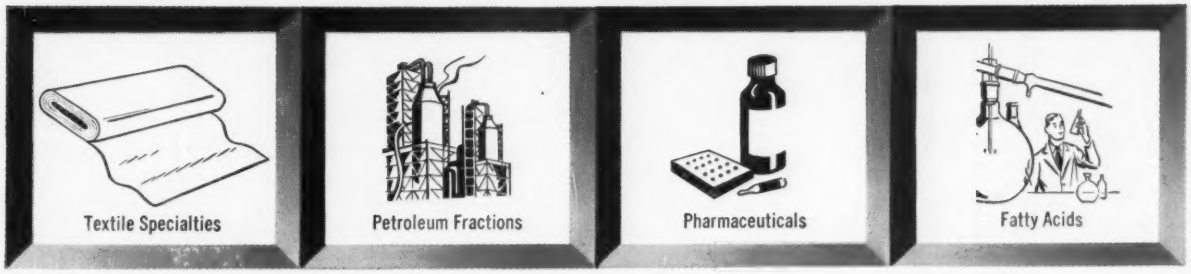
Fresh water from saline gets boost

Congress has given emphatic approval to the Interior Dept.'s saline water research program. At first only $2 million was authorized for 1952-1957, but now the ante has been raised to $10 million and the time extended through 1962.

The program was set up in July 1952 to discover cheap ways to rid brackish and sea waters of salt and other minerals. Objective was to suggest

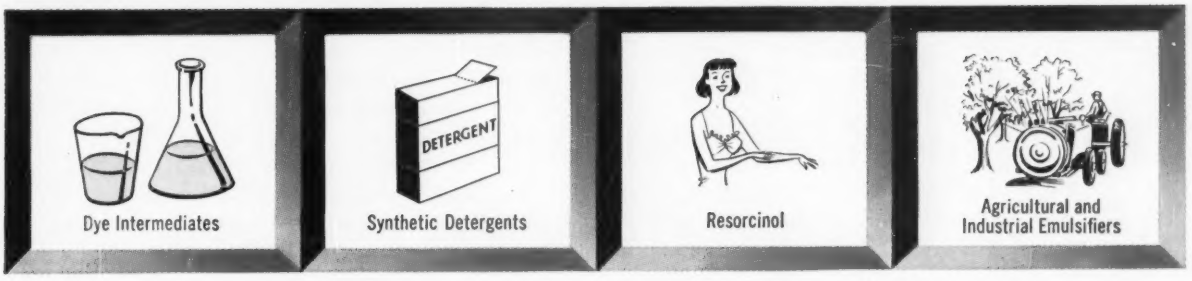
(Continued on page 110)

FOR SULFONATIONS SULFATIONS



Use SULFAN®

(Stabilized Sulfuric Anhydride)



. . . Here's Why!

You Improve Sulfonation Efficiency. SULFAN has 99.5% SO_3 available for sulfonation reactions. In many applications, this means considerable savings in operating costs because SULFAN offers nine times as much usable SO_3 as 100% sulfuric acid, and over three times as much as 20% oleum.

You Increase Batch Sizes. With SULFAN, there is no waste acid. This means larger batch sizes (or more rapid through-put) . . . often double without increasing size of equipment! Since no water is formed when SULFAN is used for sulfonation, the waste acid problem inherent with sulfuric acid or oleum is also eliminated.

Benefits of operating efficiency, ease of handling and waste acid elimination make SULFAN worth your prompt investigation. Write today for technical information. A letter outlining your specific needs will enable us to supply data of value to you. As always, information regarding your process will be held in strict confidence.

Product Development Department

GENERAL CHEMICAL DIVISION

ALLIED CHEMICAL & DYE CORPORATION

40 Rector Street, New York 6, N. Y.

GC Allied Chemical

Basic Chemicals for American Industry

various approaches to meet specific cost targets: $40/acre-ft. for irrigation, $125/acre-ft. for municipal water, $200 and above for industrial water.

Among the suggestions were electric membrane processes, vapor compression and solar distillations, critical pressure-temperature separations, osmosis, solvent extraction, freeze separations and ultrasonics. Most work so far has been bench-scale, though a bigger electric membrane device mounted in a trailer truck has been tried on brackish waters in Arizona and South Dakota.

Though the program has two years to run, Congressional action was needed. A technicality in the original law required that all parts of the program—including final reports—be in by July 17, 1957. Administrators had hoped that this deadline would limit only contract signing so that work could continue for another year or so.

Now, with more time and money, Interior can sign contracts not only to continue research, but to build 8-10 pilot plants costing $100,000 to $400,000 each. If costs are low enough in such operations local groups could then take over and build big (175 gal./day) demonstration units.

For cheaper detergents, go continuous

A revolution may be brewing in detergents—continuous sulfonation. Latest to come up with such a process for alkanes is Chemithon Corp. of Seattle. Oronite Chemical is interested in this, having worked with the developers all along.

At the same time, Girdler's Votator system for continuous sulfonation is about to go commercial and there are signs that Proctor & Gamble may be well along with its own continuous process.

Chemithon says its process cuts plant costs tremendously. Equipment for their pilot slurry unit (2 million lb./yr. on 100% basis) cost $10,000, excluding labor, would cost about $25,000 to reproduce with outside labor. This compares with $60-75,000 for a comparable packaged batch slurry plant. Product costs will be lower because of decreased capital costs and, in larger units, lower labor costs—just one operator.

Plant size has been cut drasticaly, too—the pilot plant would fit in a standard living room—and capacity can be boosted essentially by just adding more heat exchangers.

All equipment, mostly stainless steel, is standard except a modified centrifugal pump in which alkane and sulfuric acid are mixed. It's this modification—a simple one—that keys the process by giving very rapid mixing, but the company's not talking about it yet.

Cycle time for sulfonation, digestion, neutralization, dilution and settling is down from the 10-13 hr. in a batch plant to 13 min. Reaction takes 8 min., separation, 5. With shorter acid contact time, higher temperature can be used without product discoloration. The process also gives operators greater flexibility in acid concentration, acid-to-alkane ratio and acid addition rate.

In conventional sulfonation, the need to remove sizable heat of reaction to keep batch temperature within narrow limits has been responsible for oversized plants and long cycle times.

Importantly, Chemithon says its detergent product not only has better color than most made in batch plants, but oil content is as low as 0.3-0.4% on a 100% basis—about half the oil content of comparable batch products .

Pace quickens for pollution bills

Though it will likely be 1956 before Congress takes final action on the handful of air and water pollution bills before it, prospects are brighter. Bottleneck to quick action is, surprisingly, the House. The Senate has made big strides but no House committee has even held hearings.

Here's what the Senate's accomplished:

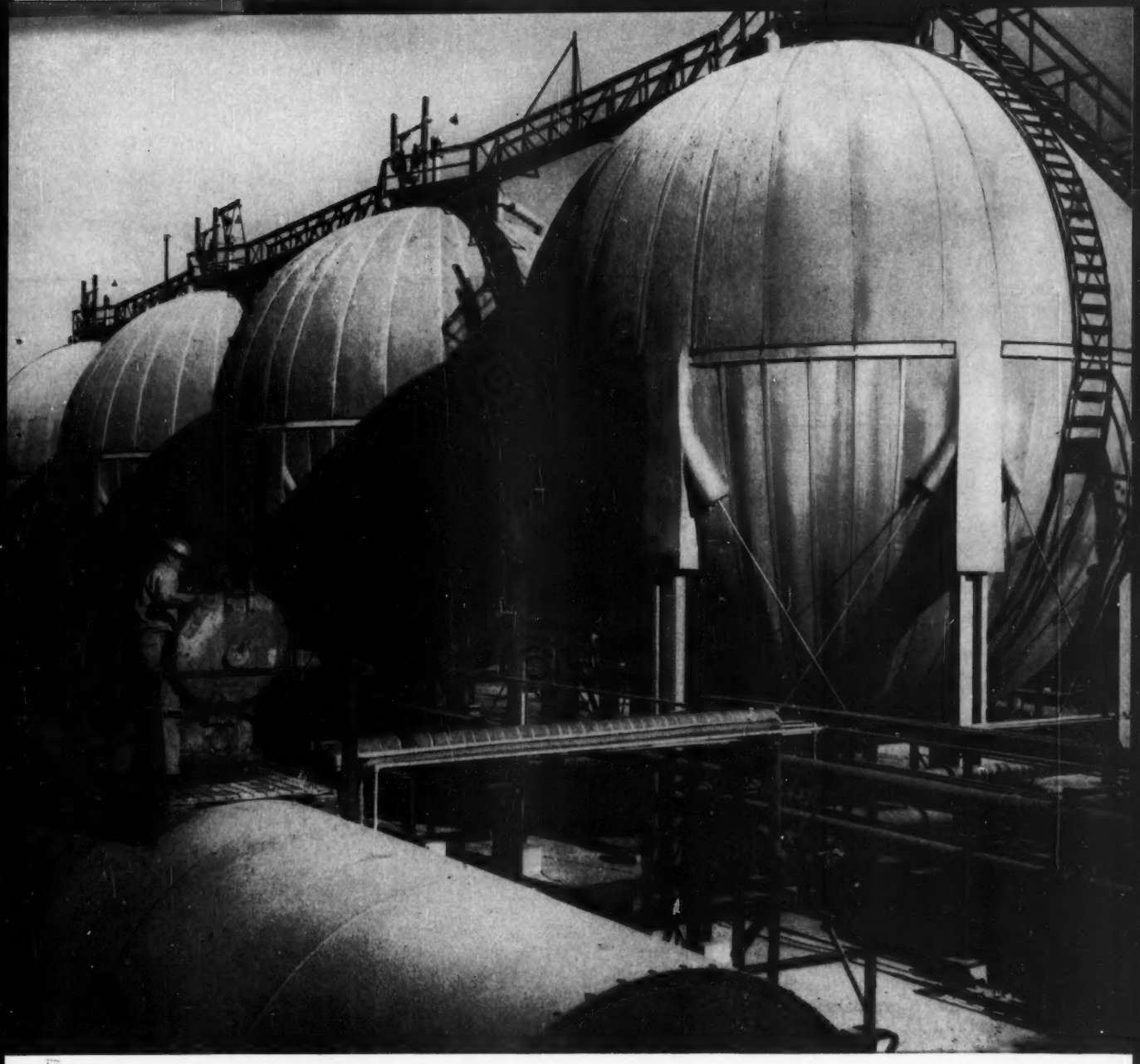
• The full body has passed a 5-yr., $15 million air pollution research program that covers research by Public Health Service and grants-in-aid to local control agencies and colleges.

• The Banking Committee has okayed a loan program to allow federal guarantees of purchase costs of air pollution abatement equipment. A similar bill passed the full Senate last year.

• The Public Works Committee has approved a bill that makes permanent the 1948 water pollution control act. However, it's not as broad as the administration wanted. Under present law, if polluted water flows across state lines, the federal government can take an offender to court only with permission of both states involved. The government wants to act without permission.

The committee proposes this: a state into which polluted water is flowing can ask for federal investigation. After two notices to a pollutor, the federal government can turn its evidence over to a court. The state can then ask this court to order the pollution stopped. This compromise is thought to be acceptable to both sides. And though there'll be more hot debate when the House takes it up, it's probable that the bill will eventually become law.

For more of WHAT'S HAPPENING. 112



Mathieson Ammonia: *balance means dependability*

As ammonia production climbs to meet growing agricultural and industrial requirements, *dependability* is more important than *availability*. At Mathieson this dependability is achieved through balance and flexibility. Three plants—Lake Charles, La., Morgantown, W. Va., Niagara Falls, N. Y.—provide both commercial and refrigeration grades in key consuming areas. A favorable balance between agricultural and industrial outlets minimizes peak-demand seasonal shortages.

Consider, too, Mathieson's balance and flexibility in the production of other basic industrial chemicals. 6 caustic soda plants, 5 chlorine plants, 7 sulphuric acid plants, 3 major alkali plants, give customers the dependability they want. In addition, Mathieson offers practical technical service in ammonia pulping and aqua preparation, as well as assistance in the application and handling of ammonia and other Mathieson basic chemicals.

Call on Mathieson when planning current or future chemical requirements. Perhaps you can buy to better advantage from one of America's largest producers of basic industrial chemicals.

MATHIESON CHEMICALS
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

MATHIESON

CAUSTIC SODA • SODA ASH • CHLORINE • SULPHURIC ACID • SULPHUR • AMMONIA • NITRATE OF SODA • BICARBONATE OF SODA • CARBON DIOXIDE • SODIUM CHLORITE • CALCIUM HYPOCHLORITE
ETHYLENE OXIDE • ETHYLENE GLYCOL • DIETHYLENE GLYCOL • TRIETHYLENE GLYCOL • POLYGLYCOLS • DICHLOROETHYLETHER • ETHYLENE DICHLORIDE • METHANOL • SODIUM METHYLATE • ETHYLENE DIAMINE

2767

JULY
1955

What's Happening

THIS MONTH'S

Feature News

Versatile Catalyst Plant	112
New Silicon Furnace	116
Molten Sulfur Barging	118
Modern CO_2 Manufacture	120
Cane Sugar by Diffusion	124
New Beet-Sugar Process	126
Suspension Polymerization	128
Triple-Threat Centrifuge	132
Convention Calendar	134
Reagent Chemicals Plant	136

New Way Developed to Dehydrate Hydrazine

To cut hydrazine production costs, Olin Mathieson, at Lake Charles, La., has turned to azeotropic distillation with aniline. The process is based on research the firm sponsored at Battelle Memorial Institute, Columbus, Ohio.

The first step of conventional hydrazine production yields a dilute water solution that can only be concentrated to about 70% hydrazine by simple distillation. Additional chemical processing will give the anhydrous form, but it's relatively expensive.

Battelle dehydrates in three steps like this: An aqueous hydrazine solution, having a composition near that of hydrazine-water azeotrope, is distilled in the presence of 70 wt.% aniline to remove about 70% (by wt.) of the water overhead as aniline-water azeotrope. The resulting aqueous hydrazine solution is then separated from the aniline. Finally, fractionation gives anhydrous hydrazine.



TABLETING PRESSES operate around the clock.

Make Catalysts to Order . . .

The Girdler Div. of National Cylinder Gas has just spent $1,000,000 to expand catalyst manufacturing. Plans to capitalize on engineered versatility.

Operations of catalyst manufacturers are booming and secrecy restrictions surrounding them are easing. Although no manufacturer is inclined to give away valuable know-how, the Girdler Co. allowed us to tour its new catalyst manufacturing plant at Louisville.

The company has just relocated and expanded its catalyst manufacturing department in new and more spacious quarters. Located on a 20-acre tract, cost of this new 75,000-sq. ft. plant exceeds $1,000,000 not including the value of equipment transferred into the new building from previously used facilities.

The building itself is corrugated aluminum on steel designed for one-level operations; but the center bay can accommodate taller equipment and processes where two stories might be an advantage.

▶ **Versatility Is Essential**—Catalyst manufacture is essentially a job-shop proposition. There are some natural-gas and petroleum processing catalysts that are produced in large enough quantities to justify continuous production plants. However, one advantage of Girdler's layout is its built-in ability to turn out large batches of different catalysts that require differing operational sequences.

in Chemical Engineering



TANKS, FILTERS and THICKENERS are arranged to maximize processing versatility.

. . . It's Good Business

Job clocks are furnished in each area in order that the 70 employees can accurately distribute their labor charges to each catalyst and each operation. A system of charging raw materials and utilities to each catalyst has been set up. Monthly production costs on every catalyst are accumulated for Girdler management.

Nearest claimant to the title of continuous production at Girdler is a nickel-base catalyst used for hydrogenation of vegetable oils and other materials. Production is scheduled around-the-clock seven days a week.

Close on its heels is nickel-base reforming catalyst. Reforming catalyst G-29, as it is known, is used in the conversion of steam-hydrocarbon mixtures to mixtures of hydrogen, carbon monoxide and carbon dioxide. G-29 used to be a straight extruded catalyst, is now also sold as a ¾-in. hollow cylinder. This catalyst increases reforming yields up to 25%, claims Girdler.

▶**No Set Pattern**–However, there is no set flow pattern from raw materials to finished product. Materials may be processed through like operations but in different sequence.

One catalyst may be calcined first and then formed. Another may be calcined after it is formed. A third may not be calcined at all. Girdler divides floor space according to operations instead of processes. As in the traditional job shop, there are machine-group areas. In this plant we found:

- Precipitation, washing and filtering.
- Drying, calcining and reducing.
- Forming to size and shape.
- Receiving, storage and shipping.

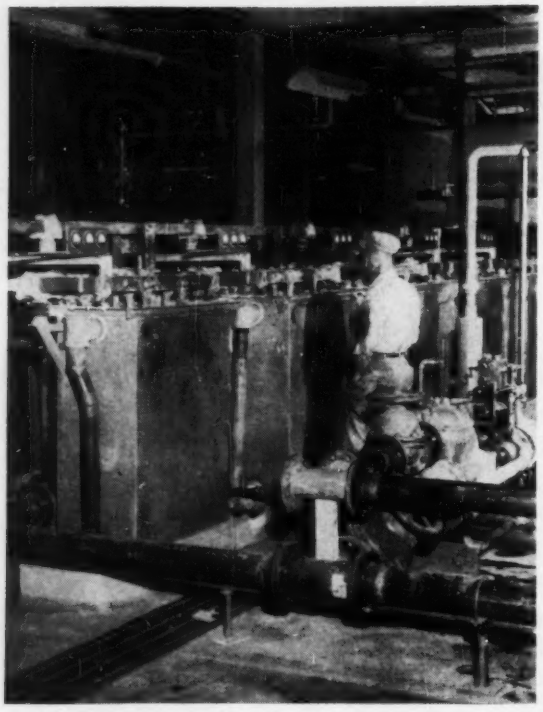
▶**Many Metal Bases**–Since the catalysts that Girdler makes can be based on nickel, iron, copper, chromium, cobalt, molybdenum, etc., provision is made for the receipt of many raw materials.

Some of the metal bases are salts, such as iron sulfate, others are the actual metals. Power scoops unload bulk solids and carry them to the proper storage bins. All packaged material–whether it be bags, boxes or barrels–is palletized and stacked.

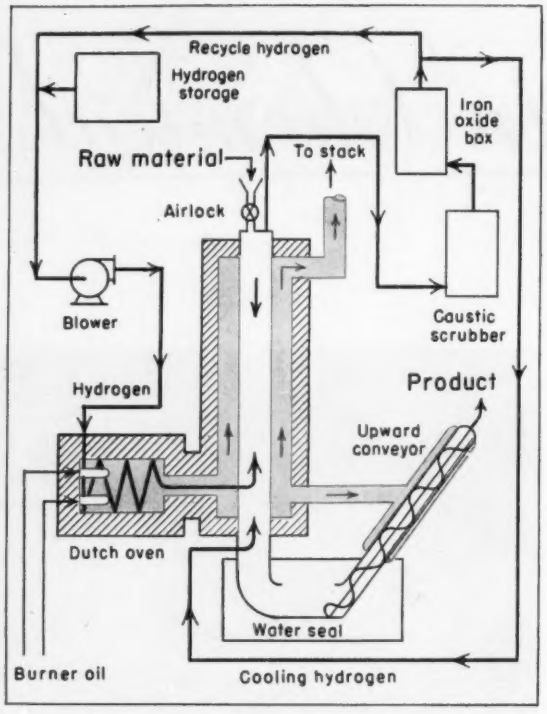
The plant also handles reagents in liquid form: sodium hydroxide, aqueous ammonia, nitric acid, sulfuric acid and hydrochloric acid.

▶**A Typical Process**–Usually the first process step is to put the catalyst bases into solution. This is done in the precipitation, washing and filtering area.

Girdler has available eighteen 10,000-gal. mixing tanks. They are fabricated from various base materials of construction and linings



ELECTRODEPOSITION of nickel hydroxide.



ACTIVATING FURNACE is a special design.

such as: mild steel, cast iron, stainless steel, lead, Hastelloy, Monel, glass and epoxy resins.

Where the volume of production is large, continuous filtration is used to advantage. For example, when producing a nickel hydrogenation catalyst, nickel hydroxide is electrodeposited on a suitable carrier and the resultant slurry is circulated from the special electrolytic cells to continuous rotary filters.

Sometimes it's advantageous to make only a partial separation. Here Shriver thickeners are used. In some operations the catalyst may be in the filter cake. In others, the filtrate is valuable and must be recycled for recovery.

▶ **Drying**–Next operation might be drying, calcining or reducing. Equipment in this area of the plant can be operated at temperatures up to 2,000 F. to effect either continuous or batch processing of catalyst tablets or extrusions.

Included are steam-heated tray dryers, rotary dryers, four electric and gas-fired tray calciners, six rotary calciners and several specially designed furnaces.

As calcining may be the last operation performed on the catalyst, provision is made on all the continuous calciners for automatic screening and packaging.

▶ **Activating Furnace**–The most interesting of these special furnaces is shown in the sketch above. It was designed by Girdler engineers for continuous drying, calcining or reduction of extrusions, tablets and coarse granular materials.

The dutch oven which produces the controlled atmosphere can easily supply gas ranging from neutral to 15 to 20% reducing at pressures from a few inches of water to several psi. Temperatures can range from a few hundred degrees up to 2,000 F. Any required proportions of CO, CO_2 and hydrogen can be supplied.

The solid being treated travels down through a stainless steel tube 2 ft. dia. by 18 ft. high. A coil in the dutch oven heats hydrogen, which then passes into the reactor tube near the bottom. The hot products of combustion pass on the outside of the tube in the annulus between the tube and an insulating shell of firebrick.

Hydrogen leaving the top of the reduction tube passes to a caustic scrubber and an iron oxide box to remove any impurities that might collect in the recycle gas. Most of the hydrogen recycles to the heating coil, but part of it recycles to a point below the entrance of the main gas stream in order to cool the solid material leaving the furnace.

The stainless steel tube has a water seal on the bottom, and the product material is continuously quenched and conveyed from the end of the tube up a spiral vibrating conveyor.

A small stream of hot flue gas dries the catalyst in the conveyor.

▶ **Forming to Size and Shape**–If catalyst is to be shaped it will in some stage of its processing go to the sizing and forming area.

Here we find hammer mills, disk mills, granulators, jaw crushers, paddle mixers, sigma mixers and



Now–A Full Line of

B&A Radioisotope Reagents

Including Carbon-14 Labeled Compounds and Deuterated Compounds

Announcing an

Important New Service

for Industrial, Scientific

and Research Laboratories



BAKER & ADAMSON®
Reagents

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Radioisotope reagents provide industrial and research chemists with unique new tools for scientific advancement. Their potential is tremendous and challenging . . . opening broad new areas of investigation in heavy industry, agriculture, biochemistry, medicine, and fundamental research.

For example, with radiochemicals industrial chemists are tracing complex flow of liquids and gases . . . measuring wear and abrasion . . . determining performance of new chemical agents . . . solving problems once considered impossible.

To supply this growing demand, Baker & Adamson now offers an extensive line of radiochemicals for general laboratory use. Included are organic and inorganic radioisotopes, including Carbon-14 labeled compounds and deuterated compounds, produced for B&A by Tracerlab, Inc.

SPECIAL CATALOG—A catalog on B&A Radiochemicals is now ready for distribution. It contains product listings, formulae, specific activities, and details on obtaining necessary Atomic Energy Commission authorization. This valuable catalog serves as an introduction to the whole field of research with radioactive chemicals. For your free copy, attach coupon to your letterhead and mail today.

Attach to your letterhead and mail.

BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.

Please send a copy of catalog, "Baker & Adamson Radiochemicals"

Name_____ Position _____

Company _____

Address _____

City_____ Zone____ State_____ CE-7

mix mullers. All material in process that needs sizing—whether it be size reduction or enlargement—will find its way to this area of the plant.

Extruders, briquetting rolls and tablet presses can prepare tablets from ¼ in. to 1 in. at rates of up to 50,000 lb. per day, cylindrical extrusions at rates of up to 25,000 lb. per day and dry powders or granular materials up to 20,000 lb. per day.

According to plant manager Paul E. Huber, this area of the plant is the most fully worked at present. For example, on some catalyst shapes, twin tools are used in the tableting machines. Then each of the 41 stations on the machines can make two tablets per revolution. This adds up to 5,000 catalyst pieces per hr. for one machine. The tableting presses run around the clock.

► **Valuable Dust**—In all working areas close attention is given to the dust. There is a possible health hazard and a possibility of contaminating the product. For control there is a vacuum-cleaning system throughout the plant with outlets every 40 ft.

But there's a positive practical angle also. In those areas where there are particularly dusty processing operations, separate collecting systems are installed. These systems recover valuable process materials and control the dust hazard as well. Whatever the last step of production may be, upon completion the catalysts are inspected by the quality control department. Production mistakes can be costly since the average selling price is about $1 per lb.

New Entry in Polyester Resins

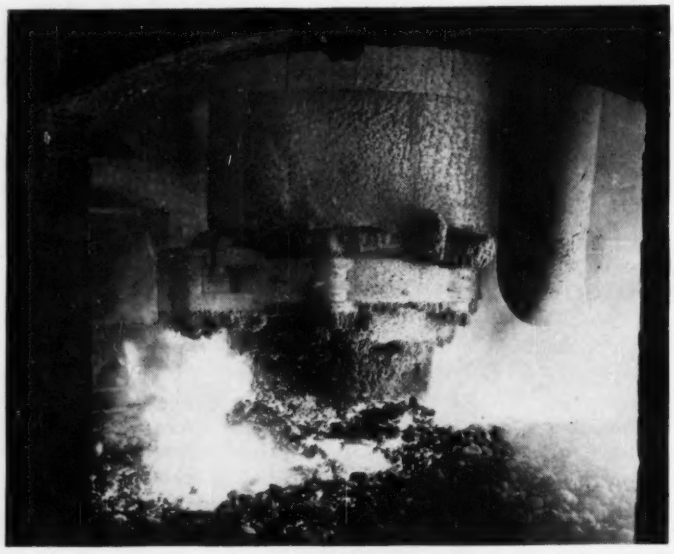
Now available is a full line of polyester resins from Sherwin-Williams Co. of Cleveland. Manufacturing and special testing facilities have been set up in Cleveland; raw materials have been produced at S/W's Chicago plant for some time.

A big factor in the decision to enter this market is the ever-narrowing gap between the paint and plastics industries. For instance, problems of pigmentation, sealing and flow are still a major concern in plastics manufacture; the paint industry has been solving such problems for years. Says Sherwin-Williams: "By bringing our knowledge and experience directly on these problems in plastics production, we feel we can speed the industry's development."

New Source Coming For Gamma Radiation

A small company in Mansfield, Mass.—The Gamma Corp.—plans to build a nuclear reactor that will produce, by an entirely new method, it's claimed, large quantities of neutron-free gamma radiation at relatively low cost. The facility will be leased to industry, research institutes and universities with the hope that it will be instrumental in bringing to fruition many of the fascinating potential uses of gamma rays in biological, chemical and physical processes.

This first reactor, which will be built solely with private funds, will be used primarily for research. But as processes prove out both technically and economically, Gamma Corp. expects to design, construct and, in some cases, operate production installations for industry. For now, though, customers will send materials to Mansfield for irradiation, then get them back for evaluation.



New 6,000-Kva. Furnace Makes Silicon

At Dow Corning's Midland, Mich., plant, a new 6,000 kva. electric furnace is being used to turn out 98% pure metallic silicon. Using three submerged-arc electrodes (one shown above), the furnace produces about 3,000 lb. of molten silicon every three hours.

The reaction involved is reduction of quartzite rock with coke and charcoal at 3,100 F. Heat is supplied by arcs from the electrodes sweeping through the charge with a rotary motion. Three sets of bus bars carry 35,000 amp. at 100 v. to each of the electrodes, which are 2½ ft. in diameter and 27 ft. long, extend 45 in. into the charge. Dow Corning uses silicon extensively in the manufacture of silicones.



BROWN & ROOT

ENGINEERING

KEY TO ECONOMY...EFFICIENCY

Today's competitive market allows no room for inefficient plant operation due to faulty engineering design.

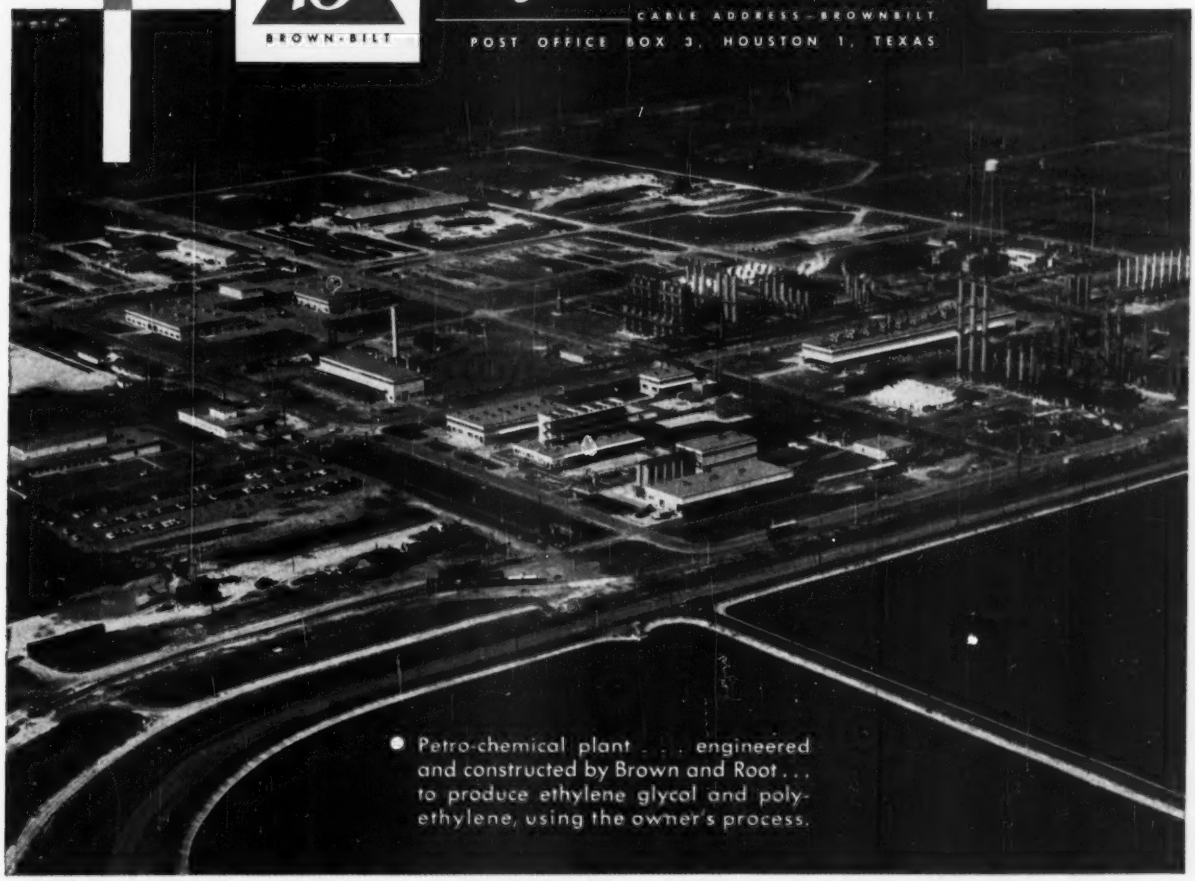
Brown & Root's extensive and diversified engineering experience is paying dividends to plant owners over the world... because their facilities ***were*** correctly designed.

Moreover, Brown & Root engineers are backed by a world-respected construction department of over forty years experience... a perfect combination for providing industry maximum dollar value.

Your inquiry is invited if you seek honest, practical advice on power generation, transmission of oil and gas, paper mills, gas conservation plants, industrial plants, or heavy marine work. No obligation, of course.

BROWN-BILT

BROWN & ROOT, INC.
Engineers ▲ Constructors
CABLE ADDRESS—BROWNBILT
POST OFFICE BOX 3, HOUSTON 1, TEXAS



● Petro-chemical plant . . . engineered and constructed by Brown and Root... to produce ethylene glycol and polyethylene, using the owner's process.

Brown & Root, Ltd., Edmonton, Alberta, Canada • Brown & Root de Mexico, S. A. de C. V., Mexico City, Mexico • Brown & Root, S. A., Panama City, Panama • Brown & Root Construcciones, C. A., Caracas, Venezuela • Brown & Root, Inc., One Wall Street, New York 5, New York

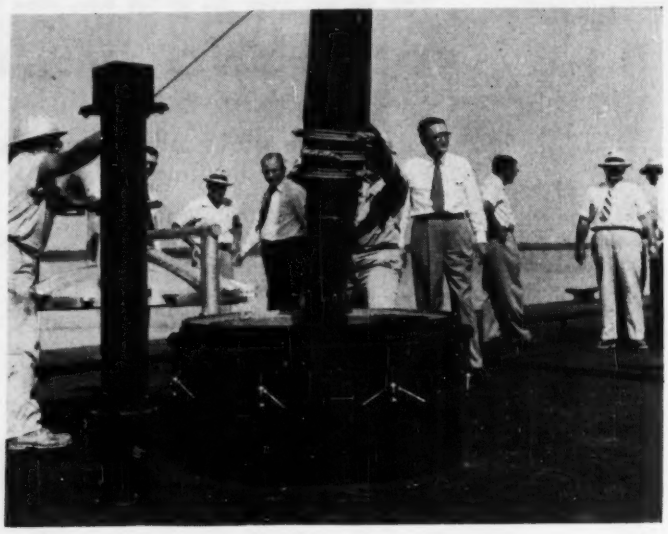
Shale Oil News, Plant and Process

How soon will we have commercial production of oil from shale? On one hand, it looks now like there may be substantial delay in the plans of Union Oil Co. of California to put up a full-scale plant in Colorado. On the other, new and improved processes are being developed, particularly by the Bureau of Mines, that should bring us closer to the goal.

Though Union wants to get going, the firm has decided that the money it's assigned to the project is not enough to include putting in a mine of its own. So now Union wants to work out a cooperative plan to get shale from the Bureau of Mines. But, says Roscoe Catell, chief of the Petroleum Div. of the Bureau, "That's going to take considerable time." Catell also has stated that production of oil from shale is very near a competitive level with petroleum; main stumbling block now is a safe, economic mining method. And it appears likely that the Bureau's Rifle, Colo., operations will continue until such a method is found, although at one point it had been decided to abandon the project.

Big reason for the nearing competitiveness of oil from shale is the process development work done by the Bureau of Mines. Latest development reported by the Bureau is a gas-combustion retorting process. As described by M. W. Putman of the Bureau before the A.I.Ch.E. in Houston this spring, raw shale moves down through a vessel countercurrent to a stream of gas, passing progressively through a product cooling zone, a retorting zone, a combustion zone and a heat recovery zone.

Most unique part of the process is the way oil vapors are cooled and condensed as a liquid aerosol in the product cooling zone. These droplets, which are carried along by the rising gas stream, must be small enough to travel through the shale bed without being separated from the gas stream. Over a limited range of operating conditions, the cooling rate is so rapid that the right size droplets are formed by self-nucleation of the oil vapors. Introduction of such foreign nuclei as aluminum oxide and sodium chloride particles greatly extended the range of satisfactory operating conditions in pilot-plant tests.



Long-Distance Molten Sulfur Barging Starts

Now moving up the Mississippi River are two insulated barges each carrying 2,500 tons of molten sulfur 1,100 miles from Freeport Sulphur Co.'s docks at Port Sulphur, La., to National Lead's titanium division plant at St. Louis. A third barge is under construction.

Molten sulfur has been shipped by rail for several years and by barge —over short distances in relatively small amounts—since 1952. Sulfur is piped into barges in the same liquid state in which it's mined, instead of being cooled and solidified. Thus dust loss is prevented, moisture avoided, contamination reduced and remelting at the consumption point is eliminated.

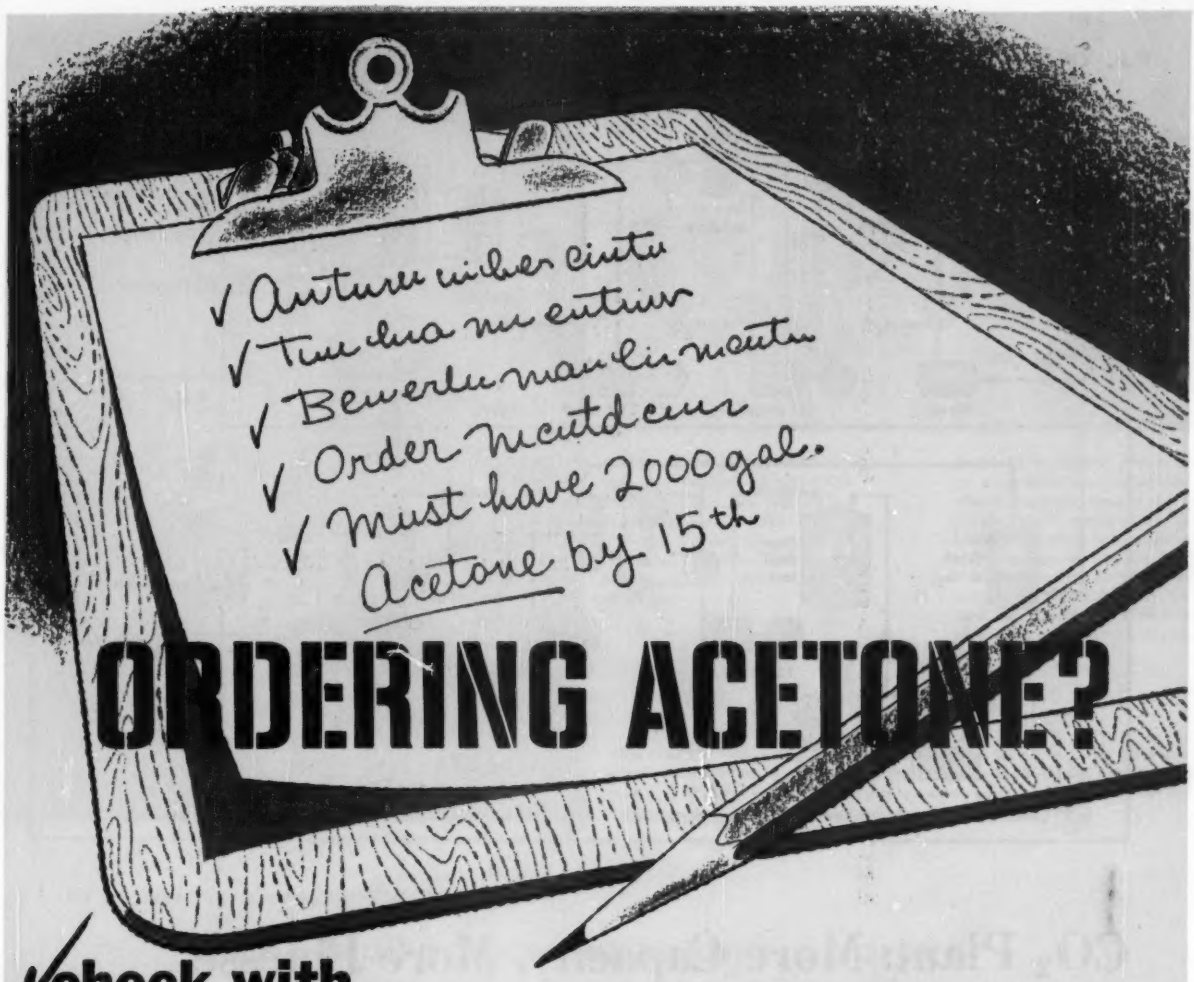
Built by Ingalls Shipbuilding Corp. and run by Coyle Lines, all three barges have 4-in. foam glass insulation and are heated to maintain 260 F. minimum.

Socony and Sharples In Thiophene Deal

Recently, Socony Mobil Oil Co. developed the first economically sound process for making thiophene. Now Socony has licensed the process to Sharples Chemicals, Inc. Sharples, a Penn Salt subsidiary, expects to start commercial production of thiophene this summer at the Houston, Tex., plant of Index Chemicals Co., another PennSalt subsidiary.

Thiophene, which is made from butane and sulfur, has properties similar to those of benzene, phenol and unsaturated hydrocarbons—unique, says Socony. Used now in dyes and pharmaceuticals, it's expected to find important applications in plastics, resins, agricultural and photographic chemicals in future years.

Commercial availability should also stimulate applied and basic research on new applications by potential users.



✓check with SHELL CHEMICAL first

Strategically located bulk depots assure prompt deliveries. Save money on multi-solvent shipments via compartment tank cars and trucks

WHEN YOU make Shell Chemical your headquarters for acetone and other solvents, you automatically have fewer supply worries.

You need never give *purity* a second thought, because Shell Chemical maintains quality-control standards that are among the industry's highest—all the way from the plant to your door.

You will find, too, that Shell Chemical is a dependable source, whether your needs are reckoned in drums or tank cars. Bulk storage depots are within convenient shipping range of every large industrial center... as close as your 'phone!

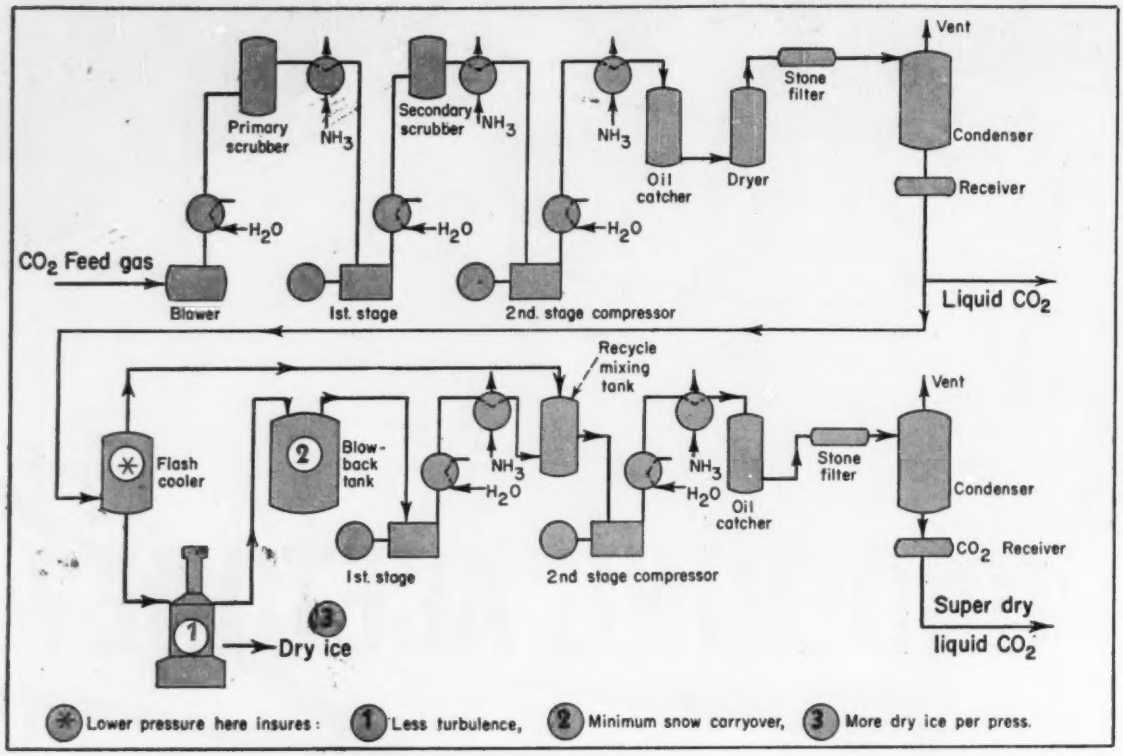
And you can keep costs low by taking full advantage of bulk prices available through compartment tank car and truck deliveries. Order several solvents at a time, and watch costs go down!

• • •

Place that next acetone order with Shell and you'll agree with thousands of other customers, small and large, that Shell is your dependable source! Write for the catalog SC:54-40 on Shell Chemical solvents.

SHELL CHEMICAL CORPORATION
CHEMICAL PARTNER OF INDUSTRY AND AGRICULTURE
380 Madison Avenue, New York 17, New York

Atlanta • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco • St. Louis
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited • Montreal • Toronto • Vancouver



CO_2 Plant: More Capacity, More Finesse

Engineering savvy at Ventura plant helps Cardox add 100 tons per day of CO_2 to bustling U. S. capacity. Features: extra-dry liquid; higher dry-ice yields.

Domestic capacity for liquid and solid carbon dioxide, up about 500 tons per day (or 12%) this year, is getting its biggest single boost from Cardox Corp., Chicago. By bringing in two 100 ton-per-day plants within one year, Cardox is quadrupling its capacity and rates now, with 265 tons per day, as an enterprising middle-sized producer.

At Ventura, Calif., the first new 100 ton-per-day plant reached full capacity this March; the second, at Memphis, Tenn., just went on stream.*

The Ventura plant, engineered and constructed by Gibbs & Hill out of its Los Angeles office, is more than a major contributor to Cardox's mounting potential. For it embodies a number of technical touches that set an example for modern carbon dioxide manufacture.

• High capacity for "super-dry" liquid CO_2: There is a growing market for this exceptionally dry grade (about 0.006% water). Aircraft and rubber industries need it to achieve liquid temperatures as low as −110 F. Ordinary dry liquid CO_2 (about 0.012% water) will go to about −100 F.

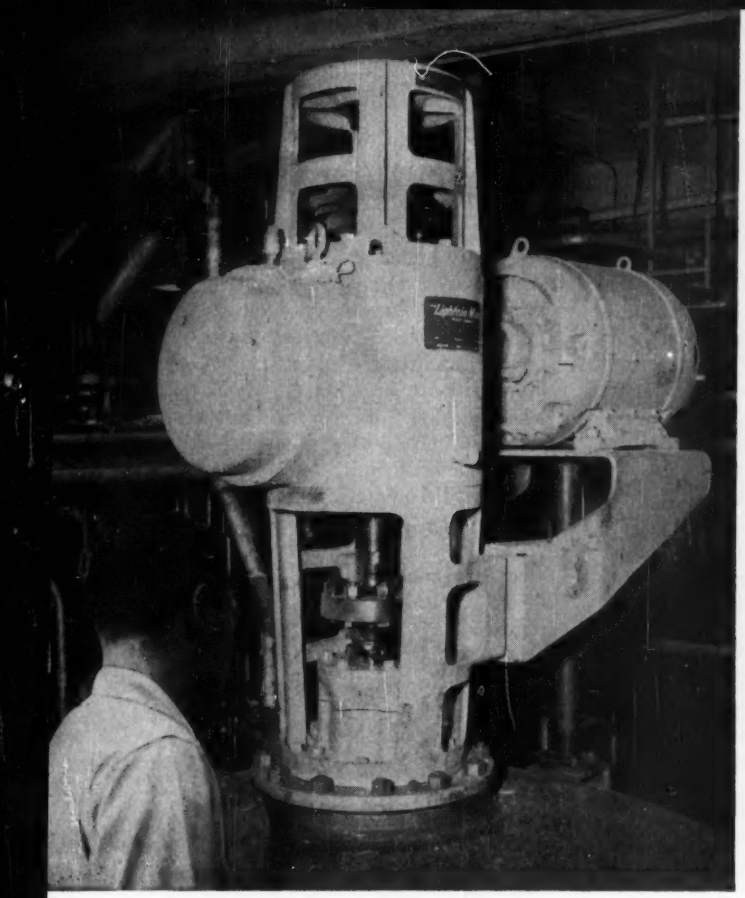
In fact, all of Cardox's present liquid output at Ventura–25 tons a day–is a super-dry grade.

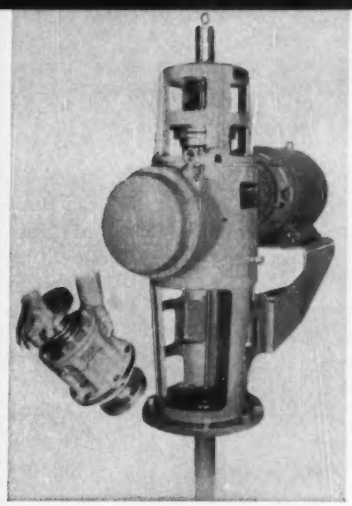
Rather than use additional dryers and banks of desiccants, Cardox and Gibbs & Hill set up a wholly separate liquefaction system–compression, condensing and storage–to handle a maximum amount of the extra-dry vapor normally available from dry ice production. (The initial cost to Cardox for raw gas also dictates recycling most of this vapor to the process.)

• Easier operation, less maintenance: Elimination of the operation-plaguing freeze-up of equipment and piping caused by excessive carry-over of snow (solidified CO_2) from the dry ice presses.

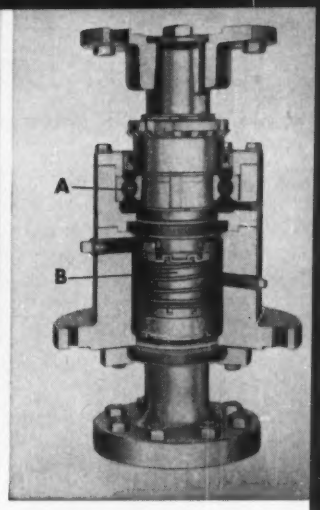
Lower-than-usual pressure–100 psig. as compared to conventional 125-150 psig.–in the liquid flash cooler is the key here. It allows use of a relatively small diameter (1 in.) vent to achieve initial CO_2

* Both draw raw material from nearby ammonia producers: Shell Chemical at Ventura; Grace Chemical at Memphis.





IF YOU CAN USE A WRENCH, you can replace a LIGHTNIN rotary seal in a few minutes. The mixer stays on the tank. Just unbolt and lift out this one-piece cartridge assembly; bolt a new one in its place; you're back in operation.



SMOOTH RUNNING. Prelubricated mixer shaft bearing (A) is part of seal assembly, close to seal for proper shaft support. But seal lubricant chamber (B) is separate from bearing—so you can choose best seal lubricant for your needs, without regard to bearing lubricant. Seal is stocked in wide range of designs and corrosion-resistant materials.

NEW LOOK in fluid mixing. This seal cartridge takes the place of a stuffing box; runs for years without adjustment; handles pressures to 1200 psig, temperatures from −120°F. to +485°F. Seals are optional equipment on LIGHTNIN top entering, side entering, and bottom entering mixers.

Newest cost-saver for fluid mixing:

End stuffing box repacking . . . forever

with a rotary seal that's easy to replace

You may get a whole new concept of the ease of mixing fluids under pressure or vacuum, when you read this story.

For here is a rotary seal that gives you leakproof, low-maintenance fluid mixing for *years,* under most conditions.

Yet *anyone can replace this seal in a few minutes,* if necessary. Without dismantling or demounting the mixer. Without draining the tank. And *without special skill.*

Here's what you gain when you specify LIGHTNIN Mixers with new LIGHTNIN Seals:

1. *You end leakage*—for good. The seal positively will not leak during its operating life. You can get standard LIGHTNIN Seal assemblies to handle pressures as high as 1200 psig; temperatures from −120°F. to +485°F. Special designs are available for more extreme conditions.

2. *You eliminate the cost* of repacking stuffing boxes. The LIGHTNIN Seal takes the place of a stuffing box. Under most conditions, it runs for *years* without changing.

3. *You stop costly "nursing"* of stuffing boxes. The seal *never* needs adjustment.

4. *You can replace* a LIGHTNIN Seal *in a few minutes,* should it ever become necessary. Only one *cartridge* component to unbolt and replace—and you're back in operation. Anyone who can handle a wrench can do it.

Already, many chemical processors are using LIGHTNIN Seals.

Users report maintenance savings running into many thousands of dollars yearly.

Your LIGHTNIN Mixer representative can give you the full story—show you how much *you* can save. Call him today. Or get the facts by mail: Send the coupon for 8-page, fully illustrated bulletin.

Lightnin® Mixers

MIXCO fluid mixing specialists

Get the cost-cutting facts now . . . New 8-page Bulletin B-111 shows how you get maintenance-free sealing that really slashes fluid mixing cost to a new low. Send also for LIGHTNIN Mixer catalogs listed here. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

- ☐ B-111 LIGHTNIN Rotary Mechanical Seals
- ☐ DH-50 and DH-51 Laboratory Mixers
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller types)
- ☐ B-104 Side Entering Mixers
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-109 Condensed Catalog (complete line)

MIXING EQUIPMENT Co., Inc., 128-g Mt. Read Blvd., Rochester 11, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 10, Ont.

expansion to the snow point in the press. This more gradual vapor removal in turn insures less turbulence in press chamber and minimizes snow carry-over.

Lower flash cooler pressures—and the consequent high vapor return to second-stage compression—yields the Ventura plant some power savings, too. Compressors are oversized in the second stage and need a high vapor feed to stay above 60 psig. and pick up horsepower advantage.

• Higher dry ice yields: Credit lower flash cooler pressures again. Because liquid fill for ice press is at a lower initial pressure and therefore colder, less vapor has to be removed to obtain CO_2 freeze-up. Result: more dry ice per pound of liquid charged to the press. Cardox claims up to 60% conversion to snow compared to about 50% for other plants. Also lending a hand: generously sized hydraulic units which actuate upper and lower press rams (40 hp. with top pressure of 3,000 psi.).

• Automatic packaging setup, reported to be the first installation in a plant of this kind: Conventional plant practice is to weigh and package ice cakes by hand.

▶**Where and Why**—Cardox's decision to build a plant at Ventura was a matter of both choice and necessity. By necessity, Cardox had been forced to relocate from a smaller plant at Niland, Calif., when nearby wells, source of raw CO_2, were gradually flooded out by a recent rise in the level of the Salton Sea. By choice: They set up their new unit next to Shell Chemical's ammonia (from natural gas) plant which had byproduct CO_2.

▶**Clean and Compress**—The Ventura plant receives CO_2 gas at 95 F. through an underground conduit from the Shell plant. Flow is through a blower and, at about 8 psig., to a primary (permanganate) scrubber for removal of entrained impurities, thence through an ammonia precooler and into first-stage compression.

Two units—two-stage, 500 hp., reciprocating, motor-driven—make up the compressor installation. Each machine can handle first and second-stage compression for three different gas streams—feed CO_2, extra-dry CO_2 and ammonia—and thereby effects lower costs.

After first-stage compression, the CO_2 moves through a water-cooled intercooler, a secondary scrubber in the form of a packed tower, an ammonia intercooler, and finally through second-stage compression. Aftercooling—to 40 F. to remove entrained water—against water and ammonia follows.

▶**Liquefy**—Cooled, compressed CO_2 gas at 40 F. and 250 psig. flows through an oil catcher, an activated alumina dryer and a stone filter to ammonia-cooled condensers. Liquid CO_2 from the bottom of the condensers goes to a 125-ton storage tank from which product is withdrawn as charge for dry ice and super dry liquid manufacture or shipped as is.

To make dry ice, the process now is one in which the temperature of liquid CO_2 is lowered in three stages by flash removal of vapor and pressure reduction until freezing occurs. In the first stage, liquid CO_2 is withdrawn from the storage tank and passed to a liquid flash cooler where the pressure is reduced to 100 psig. and the temperature drops to −50 F.

▶**Snow**—This colder liquid CO_2 enters the chamber of the dry ice press via a feed valve, where the operating pressure is 80 psi. After a predetermined time, the feed valve closes and the pressure is reduced by vapor extraction through a 1-in. line to the blowback tank. When the triple point is reached at about 40 psig. snow is formed in the press chamber.

At this juncture a 3-in. line automatically opens to reduce the press chamber pressure to a low of 8 psig., after which the presses compress the snow to cakes of dry ice. These successive pressure reductions help minimize snow carry-over.

In many plants where the cost of the raw gas is not of prime economic consideration, CO_2 vapor remaining in the press chamber at 30 psig. is vented to the atmosphere.

▶**Super-Dry**—Flashed vapor from the liquid flash cooler and the presses initiates production of super-dry liquid CO_2. Press vapor moves to a blowback tank, then through first-stage compression and water-ammonia intercooling as before. Entering the recycle mixing tank, it joins vapor from the liquid flash cooler; the mixture passes through second-stage compression and water-ammonia aftercooling.

Cooled, compressed vapor flows through an oil catcher and stone filter before condensation as a super-dry product.

▶**Press Yields**—Each of the three presses installed in the plant can make a 240-lb. cake of dry ice in 5½ min., which, says Cardox, is a somewhat higher output rate per press than in usual practice. Considerable work went into the design of the controls operating feed and exhaust valves and the speed of the upper and lower rams, work which yields optimum production conditions at each press.

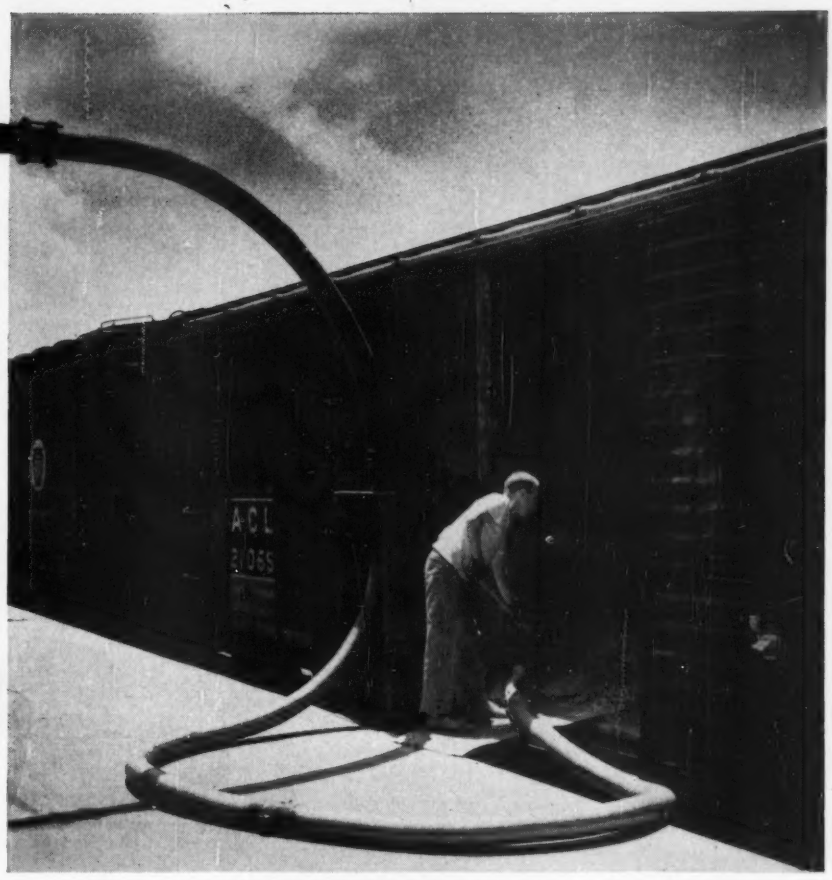
Simple interlocks control the operation sequence of the respective presses, and personnel safety got prime consideration in setting up the correct sequence.

A novel feature of the plant lies in the structural members erected independently of the building to handle heavy press parts during erection and major overhauls, or for other maintenance.

▶**Automatic Packaging**—Manual packaging and weighing have been eliminated by installation of automatic equipment; these weighers and packagers not only speed finished product handling but insure greater safety for plant personnel.

A 240-lb. cake of dry ice reaches the scales at intervals of 1 min., 50 sec., based on a 5½-min. staggered cycle for each press. Each cake measures 20 in. by 20 in. by 12 in. Fully enclosed band saws cut this into four cakes, each 10 in. by 10 in. by 12 in. The sawed cakes move down a conveyor to the automatic packaging machines where they are individually wrapped and the packages sealed. Packaged cakes ride down a gravity conveyor to the loading dock where they are transferred by hand into trucks.

this line leads to low-cost materials handling



Unloading materials at Merck & Co., Inc. with "Airstream" Conveyor

This is the "business end" of a Dracco Airstream Conveyor.

Using a single intake nozzle, the one-man operator unloads box or hopper cars as fast as a four-man crew could manually. The materials being unloaded are grains and oystershell meal—receiving them in bulk produces savings in material and labor costs.

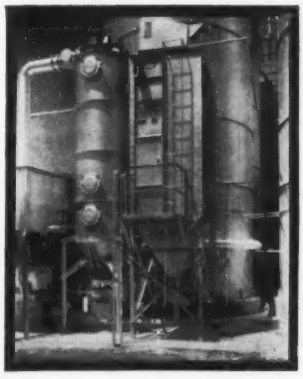
These materials are moved to storage at the St. Louis feed supplement plant of Merck & Co., Inc. through the "Airstream" conveying line . . . and it literally leads to low-cost materials handling.

Merck, long a major producer of fine chemicals, uses the grains and oystershell meal as carriers in animal feed supplements whose active ingredients are vitamins and antibiotics. In addition to labor and material savings. the Dracco installation provides dust-free handling with a completely enclosed, sanitary system. There is no loss or contamination of materials.

In any industry wherever dry bulk materials are used, the pattern is repeated —the introduction of "Airstream" Conveyors invariably leads to lower-cost materials handling. If you handle any granular or powdered material, why not follow Merck's lead and investigate the Dracco "Airstream" method. Write or call:

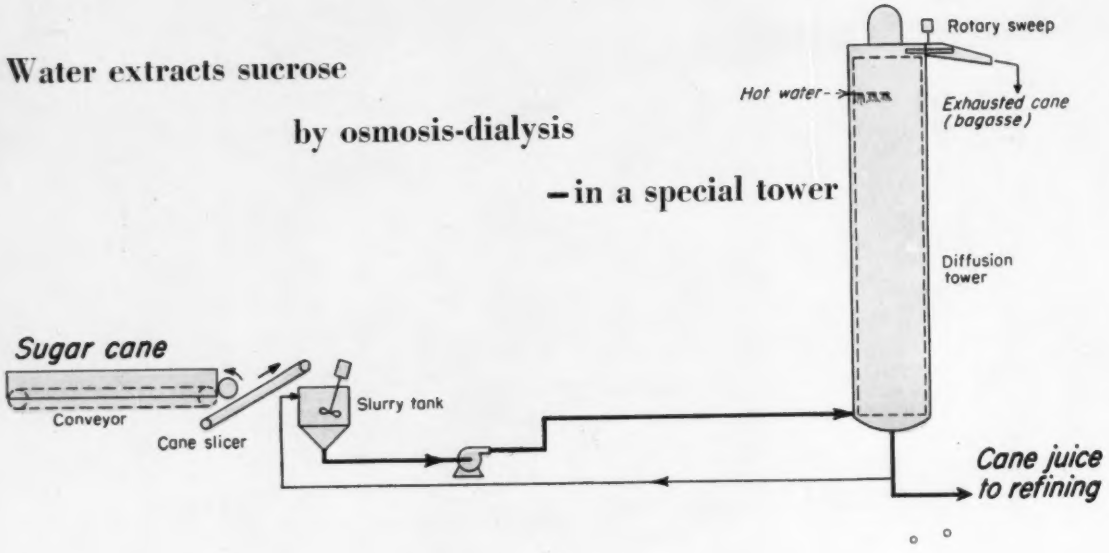
DRACCO CORPORATION
4040 East 116th Street • Cleveland 5, Ohio

Want further information on bulk materials handling with "Airstream" Conveyors? Write today for 24-page Bulletin 529.

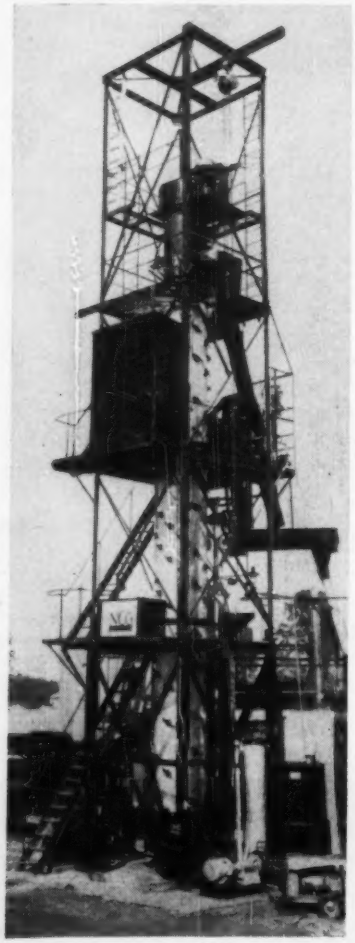


Pneumatic unloading line at Merck plant leads to Dracco equipment occupying only 300 sq. ft. of space. Materials are rushed to this point by suction, then blown into storage tanks at 6 tons per hour.

DRACCO *Performance Proved*
Airstream **CONVEYORS · DUST CONTROL EQUIPMENT**



Sucrose From Cane Via Continuous Diffusion



Higher yield and juice purity at lower cost give NCG's new process the edge over conventional milling methods. Other industrial applications seen.

In a pilot plant at the mill of Fellsmere (Fla.) Sugar Producers Assn., National Cylinder Gas Co. of Chicago has successfully demonstrated a new process—continuous diffusion of sugar cane—which has great potential for the sugar industry.

And its value to other process industries, though not yet determined, looks equally promising. Possible future applications include extraction of oil from cottonseed, tung nuts, pine stumps; washing paper pulp; pulp bleaching.

The result of four years of intensive research,* the new process differs from conventional mill operation in that it employs a combination of osmosis and dialysis to do the job ordinarily handled by the crushing and grinding action of a tandem mill train. Cane cell walls are not ruptured (as in crushing) to extract the sucrose.

But this is not the only difference between the two operations.

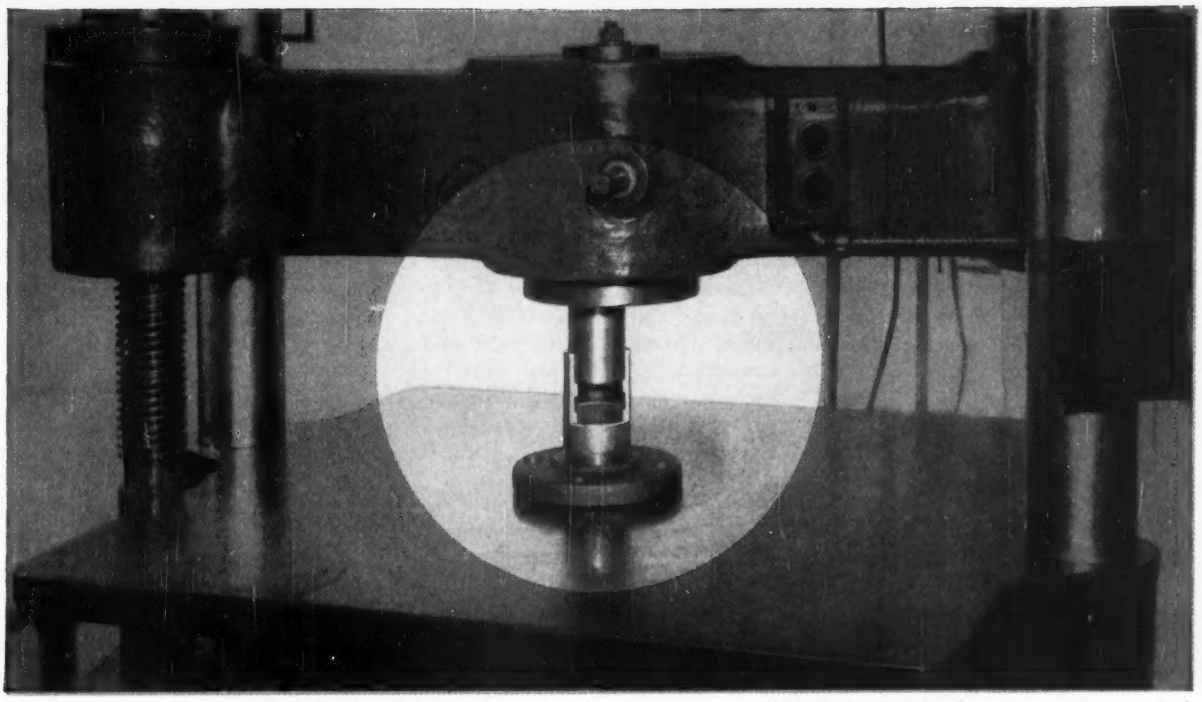
* Begun at Louisiana State University's Audubon sugar factory.

▶ **Many Advantages**—In terms of efficiency and economy, here's how continuous diffusion stacks up against orthodox mill practice:

• Higher efficiency – NCG guarantees 97% sucrose extraction, 4-5% higher than the average for present grinding methods. Juice purity, which depends upon the quality of the cane, averages about 87-89%, 2-3% higher than that of mill juice.

• Lower costs—Compared with a mill train of equal capacity, a completely installed diffusion unit costs only half as much (due to savings in steel, floor space, outdoor construction), costs only 10-25% as much to maintain, requires only 40% of the labor and 33-50% of the total power requirements.

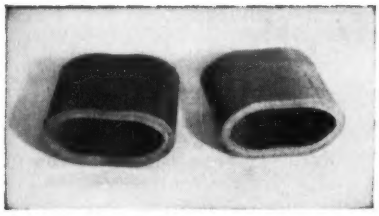
▶ **Is It New?**—Diffusion isn't new to the sugar industry. Batch diffusion—in a battery of cells—is standard practice in the extraction of sucrose from sugar beets. (Grinding is never used because the beets' pectins and starches would be extracted with the sucrose and would



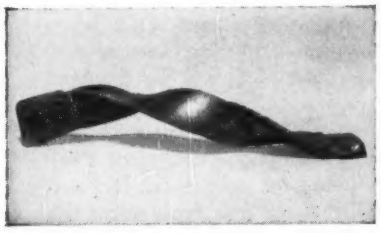
Bond holds despite shear exerted by mandrel on lead lining in test section of "Tubond" pipe.

Now...in "Tubond" pipe...a bond stronger than the tensile strength of lead

National Lead's improved bonding process inseparably weds lead to steel



Squeeze it, abuse it . . . no breaks appear in the casing, lining, or bond.



Twisted once, twisted twice . . . the second time in the reverse direction. No bond failure.

Twist it. Crush it. Manhandle it.

You just can't strip the lead lining away from National Lead's "United Tubond"® lead-lined pipe. The lining will "give" but not the bond.

Look at the test above. Here a mandrel, sized to the ID of the steel pipe minus a few thousandths, is forced through "Tubond" pipe. (A part of the side wall is cut away to show what happens.)

The lead flows, of course, and accumulates below the mandrel. But it doesn't actually pull away from the steel pipe. A thin layer of lead still remains bonded to the steel.

Now look at the twisted and crushed sections. No separation despite massive distortion. With pressure, vacuum, heat, vibration, it's the same story . . . no separation.

What weds the lead to the steel is National Lead's improved bonding process.

Proves virtually indestructible

In service, too, this bond provides an anchorage for the lining that minimizes any chance of acid leakage.

So for maximum corrosion protection, coupled with maximum mechanical strength, specify "United Tubond" pipe. Where conditions are less rigorous you may want to look into "United" expanded lead-lined pipe.

National Lead's technical specialists will be glad to help you work out the technical details of corrosion-resistant systems . . . piping, valves, pumps, coils, tanks and other elements. Just call the nearest office below.

NATIONAL LEAD COMPANY: New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.) Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Ltd.).



complicate refining operations.)

And as far back as the early 1900's, attempts were made to adapt diffusion to the extraction of sucrose from sugar cane. But because of problems in both cane handling and preparation, these experiments failed. NCG's process, therefore, represents the first such successful operation in the sugar cane industry.

▶ **How It Works**–In the new process, bundles of cane are fed by conveyor into a cutter which slices the cane transversely. The cutter has a cylindrical rotating head with a series of knives. The knife spacing and arrangement determine the size of the cane slices–usually ⅛ to ¼ in. thick.

Cane slices pass over a continuous weighing device, into a mixing tank where they are suspended in part of the hot juice withdrawn from the bottom of the diffusion tower. The suspension of cane in juice is then pumped into the bottom of the diffuser.

▶ **Inside the Diffuser**–The Fellsmere diffuser is a cylindrical steel tower–about 47 ft. high x 3 ft.–which houses a series of helical scrolls mounted on a central shaft driven at 13 rpm. NCG is not prepared, at this time, to release complete details of this mechanism which moves cane up through the tower.

Water at 190-210 F. enters the tower at the top at a rate which is controlled by the rate at which cane feeds into the bottom. As it moves down through the cane, water extracts the sucrose by a combination of osmosis and dialysis.

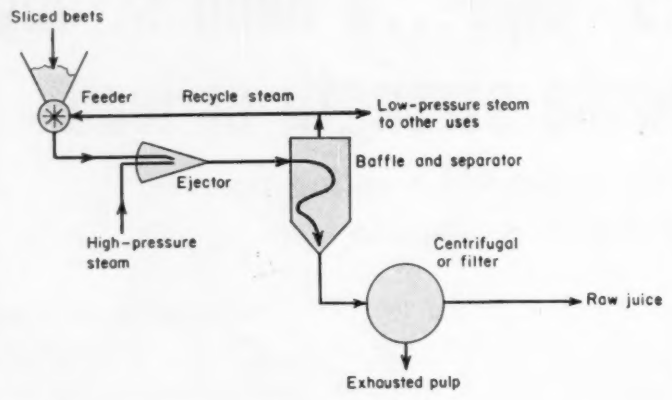
The high temperature of the water increases sucrose solubility and kills living plant cells, thus speeding the diffusion action and sterilizing the operation.

It takes 20-30 min. for the cane to travel from the bottom of the diffuser to the top. At the end of that time, exhausted cane chips (bagasse) are discharged from the top of the tower by a tangentially mounted rotary sweep.

Extracted juice leaves the bottom of the diffuser through a special screen. Part of the juice is recycled through the mixing tank to serve as a suspending medium for incoming slices. The rest goes to the refinery for further processing.

▶ **Supplement and Replacement**–At present, NCG is prepared to supply designs, plans and engineering services to install and start up operation of diffusers which can handle from 150-1,500 tons of cane per day. These units can be used to supplement and/or replace conventional grinding operations–depending upon the capacity of an existing plant.

In time, however, NCG hopes that continuous diffusion will be the mainstay of the sugar cane industry, making conventional mill operations obsolete.



For Beet Sugar, a Different Story

In view of current efforts to develop a diffusion process for extracting cane sugar (see preceding page), it seems paradoxical that the beet-sugar industry, devotee of diffusion for 90 years, is looking seriously at a mechanical process for extracting sucrose from beet pulp.

Process shown in the above flowsheet is being studied by engineers at University of Michigan in behalf of sugar-beet interests in that state. Michigan producers, faced with the prospect of modernizing their obsolete batch diffusion plants or else going out of business, aren't convinced that the continuous diffusion batteries used by beet-sugar plants in Western states necessarily represent their best investment.

And they may be right. In the new "jet" process, as the engineers at Ann Arbor point out, the equipment is simple, operates continuously, has high capacity and short hold-up time. Principle of operation is entrainment of beet slices (cossettes) in a high-velocity jet of steam and slamming the pulp against a baffle to rupture its cellular structure by a combination of mechanical impingement plus internal explosion of the cells.

Experimental operation has obtained 99% sugar recovery; quality is comparable with diffusion juice.

Chemical Industry Sets New Safety Record

Last year was the safest year yet in the chemical industry. According to a recent Manufacturing Chemists' Assn. survey, lost-time accidents totaled only 3.27 per million man-hr. worked, 11% better than in 1953. Accident severity rate dropped to 0.49 per thousand man-hours worked, a drop of 40% over 1953. Both these rates have been declining steadily since 1946.

Important, too, is the fact that the chemical industry accident rate is less than one-third of the 11.50 per million man-hours worked reported for all manufacturing by the Bureau of Labor Statistics.



chemical plants

by FOSTER WHEELER

Process design is the most important engineering function in the building of chemical plants,—in many cases the design data are of a strictly confidential nature, having to do with unusual physical-chemical characteristics of charge, products and intermediates.

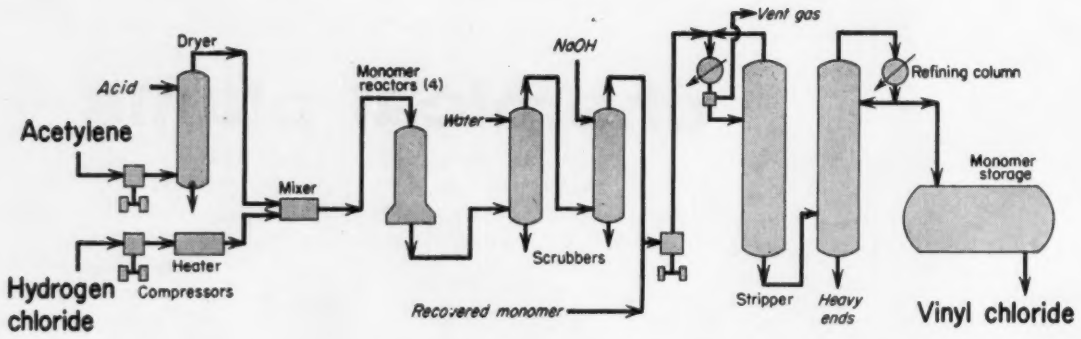
Foster Wheeler has completed a number of chemical plant installations in which the final process design was the collaborative product of the client's basic design and Foster Wheeler's cumulative design experience in many industries.

After the process design has been approved, Foster Wheeler specialists take over the detailed operations of engineering, procurement, fabrication and, finally, the construction of the complete chemical process plant.

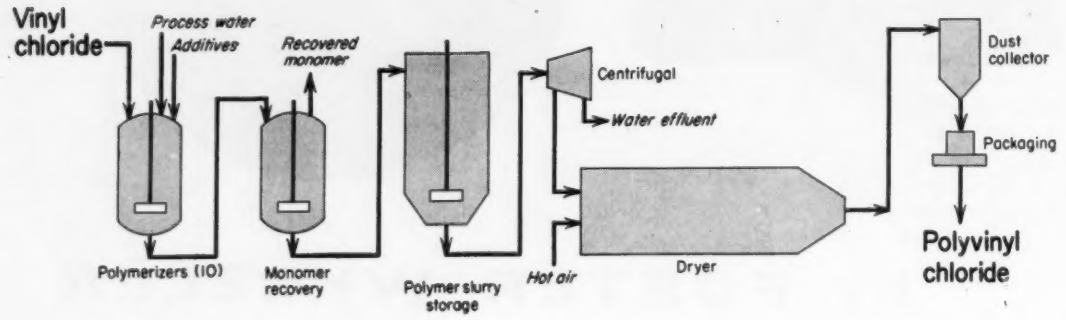
Experience proves that time and money are saved when the entire project is one contractor's undivided responsibility. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

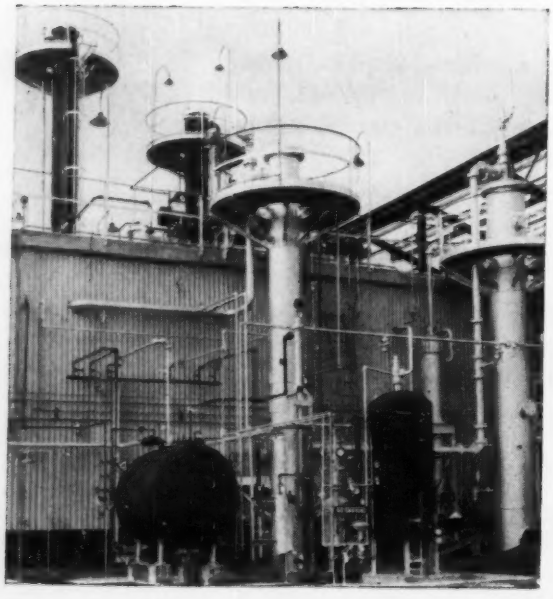
LONDON NEW YORK PARIS ST. CATHARINES, ONT.



From Vinyl Chloride to . . .



PVC by Suspension Polymerization



Versatile, low-cost process, astute engineering feature General Tire's new Ashtabula resin plant.

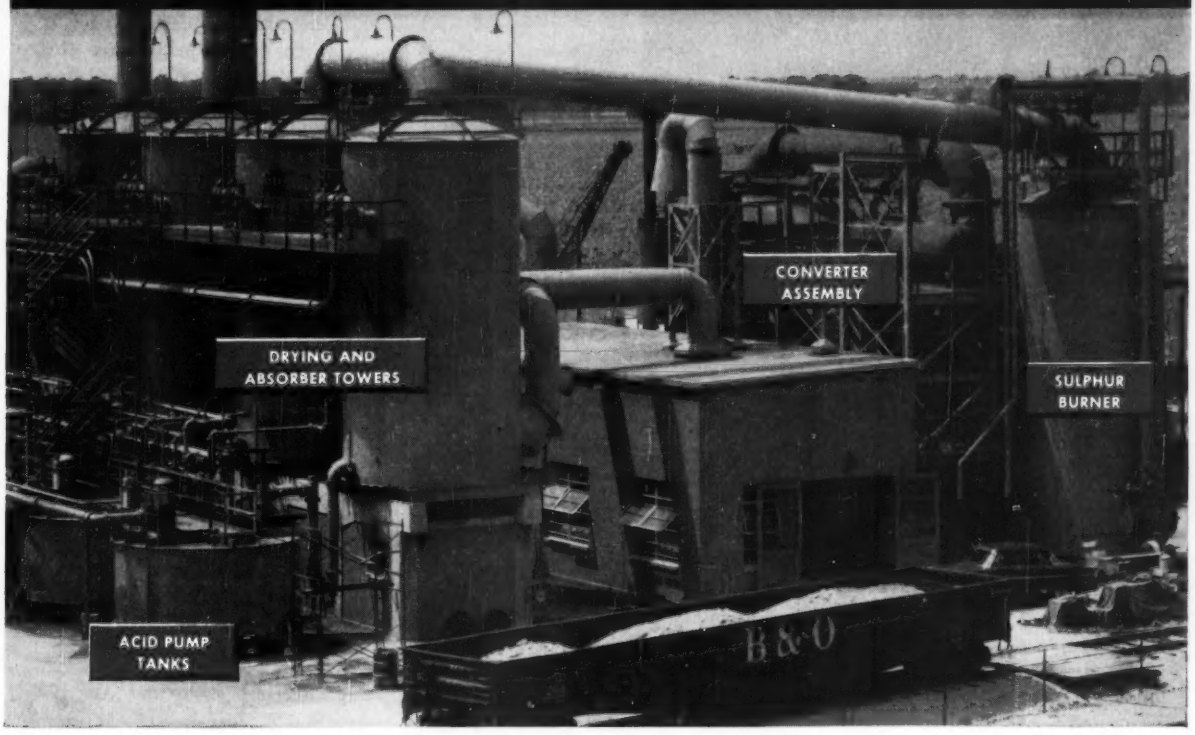
After several months' operation on purchased monomer, General Tire & Rubber Co.'s new polyvinyl chloride plant at Ashtabula, Ohio, is now in complete operation, synthesizing its own vinyl chloride from acetylene and hydrogen chloride in the unit shown at the left.

Rated at 25 million lb. per year PVC production capacity and costing $6 million, the new plant rounds out General's program of manufacture in the field of plastic film and sheeting. Last year two plastic finishers—Bolta Corp., Lawrence, Mass., and Textileather Corp., Toledo, Ohio—were merged into General Tire.

In its Ashtabula plant General has combined a versatile, low-cost process—suspension polymerization—with careful selection of process equipment to get an economical installation consistent with good engineer-

CB&I builds

Tanks, Towers and other structures for new chemical plant



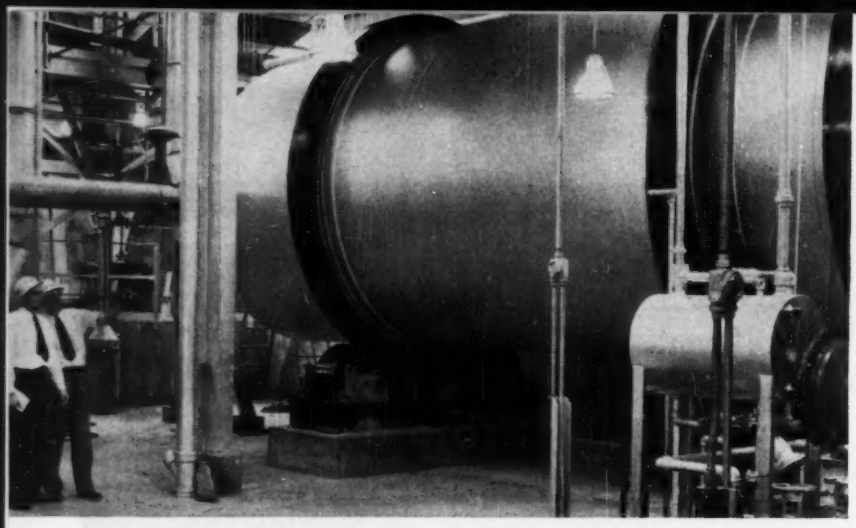
● Shown above are tanks and towers and special steel plate structures fabricated and erected by CB&I for the United States Industrial Chemicals Company at Tuscola, Illinois. If it's true that a "picture is worth a thousand words", this view should speak volumes about the wide variety of tanks and special steel plate structures that we are equipped to build for your processing operations.

When planning new structures, whether it's one tank or outfitting a complete new plant, we would like an opportunity to quote on your needs. Write our nearest office for complete information.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa • Washington
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.



ROTARY DRYER handles entire resin output of 25 million lb. per year.

ing practice. Aiding General's engineers was Scientific Design Co., New York, who designed and engineered this project.

▶ **Big Dryer**–Although last in the flowsheet, General's facilities for finishing the PVC resin deserve prominent mention.

After dewatering to 30% moisture content in three continuous solid-bowl centrifugals, the resin goes to a parallel-flow rotary dryer, 10 ft. in diameter and 40 ft. long (see above cut). Although this is an unusually large unit for such service, SD and General decided to use a single large dryer instead of smaller multiple units which would have increased the capital investment.

The dryer turns at 2 rpm. It is made of stainless steel and is equipped with internal lifting flights. Dry product contains about 0.5% moisture.

Air velocity is sufficiently high through the necked-down discharge opening–about 3,500 ft. per min. –to carry in suspension to the dust collector the entire dryer output. Air velocity in the dryer proper is about 60 ft. per min. Air used in the dryer is first heated to about 200 F. over external steam coils and filtered to remove dust or dirt.

The resin-in-air suspension goes directly to a bag-type collector, eliminating the need for any intermediate cyclone or other type of collector. The bag collector incorporates an automatic pneumatic blowback system. According to General, this unit has worked well. The only trouble was internal condensation of moisture, but this condition has been overcome by adequate thermal insulation.

▶ **Polymerization Process**–Of the four major techniques for polymerizing vinyl chloride–bulk, solution, emulsion and suspension–General chose suspension. Basis for this choice, says General, is relatively low capital and operating costs, purer product and greater versatility of product uses.

The real choice was between suspension or emulsion processes. In emulsion polymerization several percent of emulsifying agents and catalysts are used. Since the polymer is produced as a latex, these additives can't be easily removed. Carried through into the final spray-dried product, they may provide focal points for chemical attack or thermal breakdown.

In suspension polymerization the additives (suspending agents and catalysts) amount to less than 1%. And most of the additive content leaves with the water when the "sandy" polymer slurry is centrifuged. Suspension PVC is, therefore, almost pure polymer.

On the other hand, emulsion polymerization readily lends itself to continuous operation, whereas suspension polymerization does not. General Tire and Scientific Design have minimized the apparent disadvantage of batch operation by using the largest polymerizers available. This has reduced the number of units required and saved in building space.

The ten polymerizers are 3,500-gal., glass-lined steel reactors. Charged essentially full, they operate at 110-150 F. Cycle times vary from 12 to 24 hours, depending upon the particular product formulation.

Process water for polymerization comes from nearby Lake Erie and is used after complete demineralization and deaeration.

▶ **Making the Monomer**–General makes vinyl chloride monomer by the conventional reaction of acetylene and hydrogen chloride over a catalyst of mercuric chloride on activated charcoal. Incoming acetylene is scrubbed with acid to remove water.

The plant has four monomer reactors–three in use and one spare. They are manifolded and valved for flexible operation. The reactors are said to be larger and more efficient than those used in earlier plants.

Reaction pressure is normally 7 to 10 psi. gage. Temperature is between 200 and 300 F., depending on the age of the catalyst. Temperature is controlled by forced circulation of a heat-transfer oil. The oil can be heated with steam or cooled by generating low-pressure steam.

Vinyl chloride is purified by water and caustic scrubbing, followed by stripping of the low boilers and fractional distillation to remove the heavy ends. All construction is steel, except the water scrubber system and the overhead system of the fractionating column. The former is saran-lined steel, graphite or ceramic; the latter is of Type 304 stainless steel.

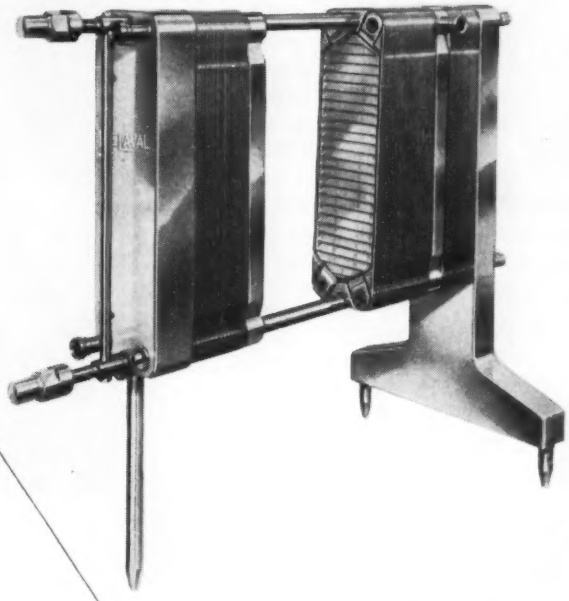
Degree of conversion of HCl and acetylene to vinyl chloride is determined by an automatic infrared recording analyzer sensitive to HCl. Sample point is at the outlet of the monomer reactors. Another infrared analyzer records and controls the composition of the tail gas leaving the stripper. If acetylene concentration should exceed 40% by volume, nitrogen is added to the system.

▶ **Why Ashtabula?**–General Tire chose to locate its PVC plant at Ashtabula for a number of reasons:

• Raw materials are available by pipeline–acetylene from Linde Air Products and anhydrous HCl from Hooker-Detrex.

CHECK POINTS

Your Next Plate Heat Exchanger Should Match!...



- **Does it have a high coefficient of heat transfer?**
- **Will it stand high pressures?**
- **Is assembly and disassembly easy and positive?**
- **Is there provision for *precision* tightening?**
- **Are gaskets readily replaceable?**
- **Is it designed for easy cleaning, either by backflushing or hand washing?**
- **Can interior surfaces be easily inspected?**
- **Is it flexible to meet changed operating conditions?**
- **Is it well-built for long, trouble-free life?**

Because De Laval Plate Heat Exchangers meet *all* these requirements . . . they have established themselves as the finest ever offered to American industry.

Get *full* information *now* . . . write for De Laval Plate Heat Exchanger Bulletin.

DE LAVAL
plate heat exchangers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • **DE LAVAL PACIFIC CO.** 61 Beale St., San Francisco 5

• Water is in adequate supply from Lake Erie.

• The same goes for power. Cleveland Electric operates a 240,000-kw. generating station within sight of General's plant.

• Water, rail and highway transportation facilities serve the area well. Plant is strategically situated relative to markets.

General originally contemplated locating its plant at Calvert City, Ky. Comparing Ashtabula with Calvert City, General has saved $500,000 in investment because of shorter connecting pipelines and availability of an existing water system. Lower transportation costs on outbound products amount to additional savings of $150,000 to $200,000 per year.

▶ **Chemical Community**—With this plant, General joins a growing community of chemical interests, based on limestone, salt, coal and coke, power and water. Electro Metallurgical Co. turns limestone, coke and power into calcium carbide. Its sister division of Union Carbide, Linde, generates acetylene and pipes it to Hooker-Detrex and General Tire.

National Distillers converts salt and power into sodium and chlorine. Hooker-Detrex takes some of this chlorine, reacts it with Linde's acetylene to make tetrachlorethane, then cracks the tetra to trichlorethylene. Anhydrous HCl, by-product of the cracking reaction, goes to General.

Latest arrival on the Ashtabula scene is Archer-Daniels-Midland, whose new plant across the street from National Distillers will use some of the latter's sodium in the production of fatty alcohols. ADM is just getting its operations underway.

Next to come will be an Electro Met plant to make titanium, using sodium as the reducing agent. And now National Distillers itself is said to be considering getting into the titanium business as a logical development of its position in sodium.

The chemical industry has already invested more than $100 million in Ashtabula County, and the end isn't in sight.



3 Keys to Clear Solution

- **Perforate bowl traps coarser, floating solids.**
- **Solid bowl settles remaining, finer particles.**
- **Vacuum frees liquid of dissolved air and foam.**

How engineering ingenuity can overcome obstacles to make basic principles work was demonstrated recently by engineers of Eastman Kodak Co. Convinced that gelatin could be clarified successfully by centrifugal force, they developed a new centrifuge when commercially available units failed to do the job.

After many months' operation Eastman reports that the new centrifuge removes from gelatin solutions essentially all floating and settling solids, dissolved air and foam. And the solutions are free from degradation by bacterial attack.

Eastman's centrifuge is a double-bowl machine that can process a 30-gal. batch of gelatin solution under a 29-in. vacuum. Double bowl is designed to filter and settle in one operation. Special liquid discharge under vacuum overcomes foaming and aeration troubles. Solution temperature can be controlled closely.

Machine is free of stagnant pockets and can be flushed thoroughly in less than 10 min. Total holdup in the bowl is only 0.7 gal. so that product loss is small during cleanout. (*Continued*)

DU PONT

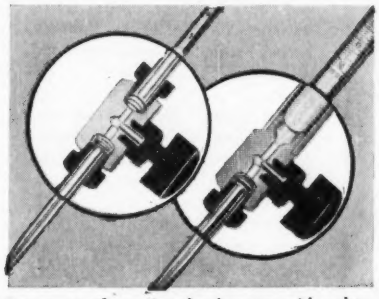
Better Things for Better Living ... through Chemistry

CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

NO. 6 — 1955

New needle-valve burettes use "TEFLON" to prevent leakage, sticking, contamination

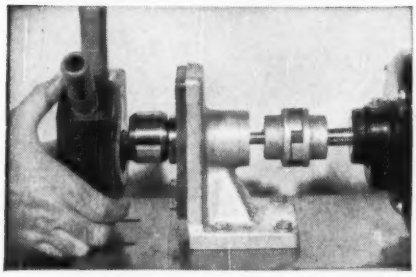


Two types of needle-valve burettes with valves made of Du Pont "Teflon" tetrafluoroethylene resin. (Manufactured by the Emil Greiner Company, New York City, N. Y.)

A new line of needle valve burettes, recently introduced, can perform titrations for very fine micro measurements without the annoyance of stopcock adjustments. The valve is made in part of Du Pont "Teflon" tetrafluoroethylene resin. "Teflon" resists breakage, prevents leaks and eliminates grease contamination in the stopcock. This engineering material is inert to all industrial chemicals. Its working temperature range extends from –450°F. to 500°F.

Use the coupon below for more information on versatile Du Pont "Teflon."

Pump body block molded of ALATHON® simplifies design



This patented "Flex-i-liner" pump features a body block of molded Du Pont "Alathon" polyethylene resin. "Alathon" is tough, non-contaminating, and resists corrosive fluids. It resists abrasive slurries.

The manufacturer has been able to reduce parts and increase pump efficiency with the body block of "Alathon." Pump design eliminates stuffing boxes and shaft seals, so external leakage from these sources is avoided. The pump is self-priming–needs no check valves or gaskets. And because "Alathon" is lightweight (sp.gr. 0.92), the pump is easier to handle.

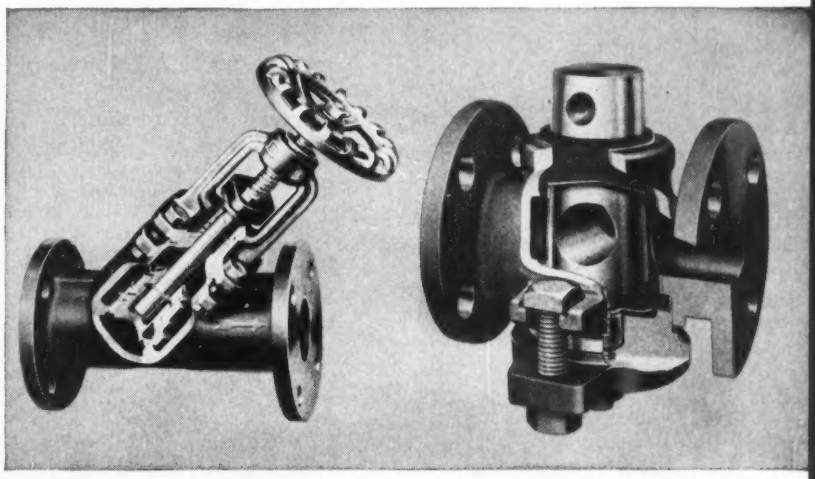
Can you utilize versatile Du Pont "Alathon" for your operation? Use the coupon for full property data. (Pump manufactured by Vanton Pump and Equipment Corp., New York City.)

Disc Rings and Sleeves of TEFLON® Prolong Valve Life

Disc rings and reinforced sleeves of Du Pont "Teflon" tetrafluoroethylene resin give a tight seal against pressure and vacuum. They have good impact strength and abrasion resistance under normal conditions of speed and load. Toughness and flexibility are retained at temperatures as low as –450°F. "Teflon" gives continuous service up to 500°F.

"Teflon" has zero water absorption—won't shrink, crack, swell or harden because of moisture. And it's inert to all chemicals except molten alkali metals and fluorine at elevated temperatures and pressures.

These remarkable properties have reduced maintenance time, increased service life and efficiency for Durco Type F and Types J and K "Y" valves manufactured by The Duriron Company, Inc., Dayton, Ohio.



"Y" valve has disc ring and stem packing of Du Pont "Teflon" tetrafluoroethylene resin for longer service, positive sealing.

Durco Type F valve with sleeve of "Teflon" avoids metal-to-metal contact, and assures dependable service with no galling, no sticking.

NEED MORE INFORMATION?

CLIP THE COUPON for additional data on the properties and applications of these Du Pont engineering materials.

**"Teflon," "Alathon," "Zytel" and "Lucite" are registered trade-marks of E. I. du Pont de Nemours & Co. (Inc.).*

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 257, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited,
P.O. Box 660, Montreal, Quebec.

Please send me more information on the Du Pont engineering materials checked: ☐ "Teflon"* tetrafluoroethylene resin; ☐ "Alathon"* polyethylene resin; ☐ "Zytel"* nylon resin; ☐ "Lucite"* acrylic resin. I am interested in evaluating these materials for_____

NAME_____

COMPANY_____ POSITION_____

STREET_____

CITY_____ STATE_____

TYPE OF BUSINESS_____

▶ **Why New Machine?**—Unclarified gelatin solutions normally contain solid particles with a wide range of size and density. Some particles sink, others float. Removal of these solids is hindered by high solution viscosity (80 cp.), strong foaming tendencies and susceptibility to bacterial attack.

Eastman found that the solutions could be cleaned by filtering them centrifugally through high-quality, fine-grain filter paper, followed by centrifugal sedimentation at 2,000 times gravity. Dissolved air could be removed by pulling a 29-in. vacuum over the solution.

With existing commercial equipment this procedure had to be carried out stepwise. Furthermore, throughput was low because the solution foamed excessively in discharging from the centrifuges. Once the foam was generated a number of vacuum deaerating cycles were needed, during which time bacterial degradation could ensue.

Also, the product was found at times to contain traces of dirt. Apparently, lack of baffles in the centrifuges permitted short-circuiting of the solution, resulting in carryover of suspended solids.

▶ **Objective Set**—Ultimate design of a new centrifuge to perform all desired operations simultaneously revolved around one question: Was vacuum essential?

Attempts to remove a foam-free solution from a centrifuge by a conventional skimming nozzle were not successful. Thus vacuum was needed and mechanical design became a major problem. For use of vacuum entailed solving many difficulties relative to seals, basket suspension, bearing mounts and lubrication, sanitary construction and removal of product.

▶ **Objective Reached**—To overcome the difficulties imposed by vacuum operation the centrifuge is enclosed within a jacketed vacuum chamber or collecting vessel. The basket is supported on a strongly braced, rigidly mounted spindle driven by an externally located motor. A double, water-cooled, rotary mechanical seal provides a vacuum-tight seal where the shaft enters the collecting vessel.

With such a rigid mount, required for sealing, the rotating assembly had to be balanced precisely to avoid unbearable vibration. This was done with a special type of resonance balancing machine normally used for balancing turbine rotors. Operation is extremely smooth with a maximum vibration amplitude of only 0.000485 in.

Twelve-inch diameter bowl assembly rotates at 3,500 rpm., has two concentric cylindrical walls—the inner perforate, the outer imperforate.

The perforate section is lined with filter paper. The imperforate has horizontal ring baffles with smaller I.D. than the overflow lip to prevent short-circuiting. Liquid can move from the bottom of the basket toward the discharge lip only by flowing through several small holes located near the outer diameter of the horizontal ring baffles. Vertical baffles keep the liquid from surging inside the solid bowl.

Foaming is held to a minimum by using baffles to direct flow between the bowl sections and from the discharge point to the bottom of the collecting chamber. Also, jet discharge from the bowl through notches reduces foaming.

▶ **Protection**—An elaborate system of protective devices prevents damage to the equipment and completely protects the operator. The centrifuge can only be started after the cover is closed and locked in place, and the shaft-seal cooling water is flowing. A time-delay relay makes it impossible to open the cover when the machine is running.

Convention Calendar

American Society for Testing Materials, 58th annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-July 1.

American Nuclear Society, first annual meeting, Pennsylvania State University, University Park, Pa., June 27-29.

Technical Association of the Pulp and Paper Industry, conference on statistics in the paper industry, Forest Products Laboratory, Madison, Wis., July 10-23.

Western Plant Maintenance and Engineering Show, Pan Pacific Auditorium, Los Angeles, July 12-14.

American Oil Chemists' Society, short course on analytical techniques, University of Illinois, Urbana, Ill., Aug. 1-5.

International Conference on the Peaceful Uses of Atomic Energy, sponsored by the United Nations, Geneva, Switzerland, Aug. 8-20.

National Industrial Conference Board and Stanford Research Institute, symposium on Electronics and Automatic Production, Sheraton-Palace, San Francisco, Aug. 22-23.

American Soybean Assn. and National Soybean Processors Assn., joint annual meetings, Netherland Plaza Hotel, Cincinnati, Aug. 29-31.

Zirconium: Price Cut, Production Curtailed

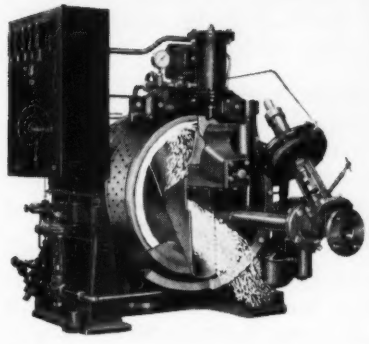
Prices of zirconium—both reactor and commercial grades—have been slashed up to 40% by Carborundum Metals Co. of Niagara Falls, N. Y. Almost simultaneously, the Bureau of Mines got out of the zirconium business.

New prices are: commercial grade ingots, $14.40 a lb. (were $22.00); reactor grade sponge, $14.00 a lb. (was $22.00); low-hafnium grade ingots, $23.07 a lb. (were $33.00). These drastic cuts, says Carborundum, were made possible by "our ability to reduce the cost of basic metal, the selection of well-qualified fabricators and, particularly, the ability of these fabricators to increase their yields of acceptable, on-specification material." Increased demand was also a big factor.

Carborundum has been the only private producer of low-hafnium zirconium, and now that the Bureau of Mines has stopped all zirconium production at Albany, Ore., Carborundum will supply the metal to the AEC. The Bureau's plant, using the Kroll process, had

from Mother Liquor to DRY CRYSTALS...

AUTOMATICALLY



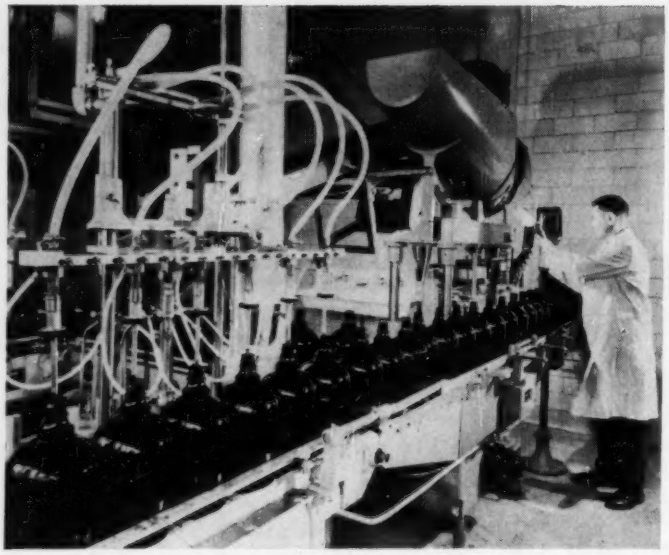
That's the short story of the Sharples Super-D-Hydrator. This high efficiency crystal dehydrator automatically compensates for changes in feed and concentration rate, and by simple external adjustments, any degree of dryness can be obtained at will.

The Super-D-Hydrator is built for the most rugged, day-in and day-out service. Actual performance records on hundreds of these centrifuges shows long time high efficiency production with phenomenally low maintenance.

Check the facts on low cost crystal dehydration. Sharples Bulletin 1257 is the first step.

SHARPLES

THE SHARPLES CORPORATION
2300 WESTMORELAND STREET • PHILADELPHIA 40, PENNSYLVANIA
NEW YORK • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON
Associated Companies and Representatives throughout the World



Big Reagent Chemicals Plant Goes on Stream

First and biggest! That's how Fisher Scientific Co. characterizes its just-opened Fairlawn, N. J., plant. Says Fisher: It's the very first plant in America designed exclusively for reagent chemicals and it has the largest capacity for such chemicals in the world.

Most of us think of reagent chemicals in very small quantities. But Fisher, particularly in its new $1.2 million plant, makes them on a pretty hefty scale (witness the assembly-line packaging of reagent-grade sodium hydroxide above). However, the firm emphasizes that no quantity is too small to be bothered with if the analyst has the need.

a capacity of 300,000 lb. a year. Though Carborundum's Akron, N. Y., plant is only half that size it is sufficient for immediate national needs.

Complete Tall Oil Unit Now Going Up

By early next year Union Bag & Paper Corp. will have a new tall oil distillation plant capable of processing 15,000 tons a year of crude oil. Located adjacent to the firm's present facilities at Savannah, Ga., it's being designed and constructed by Foster Wheeler Corp. of New York City.

The unit will separate crude tall oil into resin and fatty acids. When completed the over-all Savannah operation will be the only one in the country producing crude and refined tall oil, distilled tall oil and tall oil resin and fatty acids.

Coming Soon: More Canadian Lithium

Aiming ultimately at production of lithium chemicals, Quebec Lithium Corp. of Toronto now plans to erect a $3 million plant near Barraute, Que., to turn out 1,000 tons a day of lithium concentrates by a flotation process. Lithium Corp. of America has already contracted to take 165 tons of this daily output. Designs include provisions for eventual expansion to 2,000 tons a day.

Ore for the new mill will come from Quebec Lithium's mine in Quebec which has estimated reserves of 15 million tons, one of the biggest proven deposits in the world.

Styrene Expansion Planned in Louisiana

On stream for little more than a year, the Baton Rouge styrene monomer plant of Foster Grant Co. is about to be doubled in capacity—from 24 million lb. a year to more than 50 million (*Chem. Eng.*, July 1954, p. 120). And with this new production the company will enter the open market for styrene for the first time.

Foster Grant has been using all the plant's output for its own polymerization facilities in Leominster, Mass. But much of the added production will go to the nearby rubber plant recently acquired from the government by Copolymer Rubber and Chemical Co.

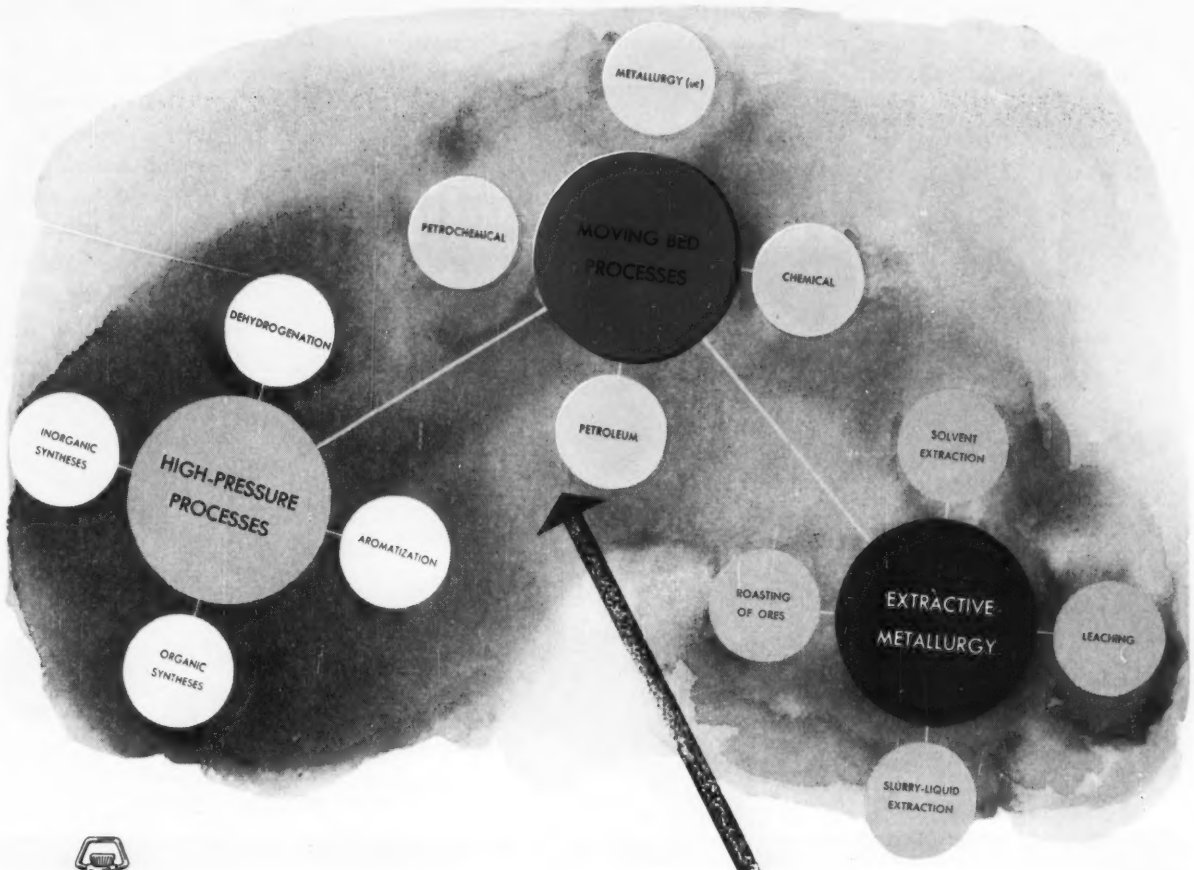
News Briefs

Merger: Olin Mathieson Chemical Corp. plans to acquire Blockson Chemical Co. of Joliet, Ill., by merger. If stockholders of both companies agree, for every share of Blockson, shareholders will get three-quarters of a share of Olin Mathieson.

Rayon: American Viscose Corp. is adding a total of 90 million lb. a year of viscose staple capacity to its Front Royal, Va., and Parkersburg, W. Va., plants. When completed the firm's capacity will be 300 million lb. a year, 60% of the U. S. total.

Ammonia: Escambia Bay Chemical Corp. has broken ground for a $30 million plant at Pensacola, Fla., that will make ammonia and other nitrogen products. Escambia is owned by United Gas Corp., Electric Bond and Share Corp., and National Research Corp.

Vinyl Acetate: Celanese Corp. has just doubled its vinyl acetate capacity at Pampa, Tex. Facilities to make methyl ethyl ketone are also being installed there.

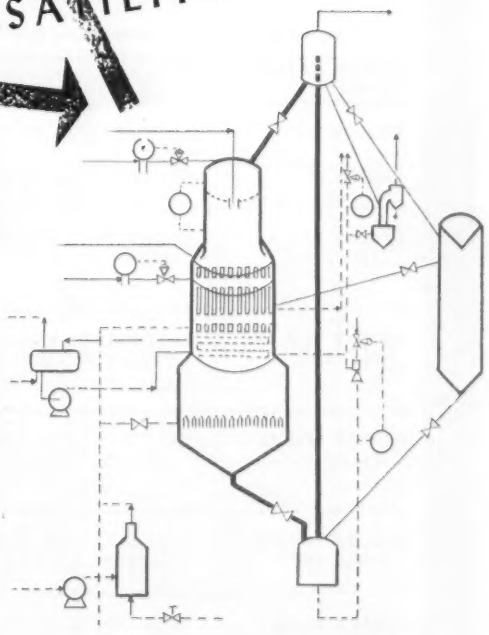


CATALYTIC CONSTRUCTION · 100% ON TIME ·

BALANCE AND VERSATILITY

One important part of Catalytic's balance and versatility is a large staff of process engineers whose broad experience is available to you in the metallurgical, chemical, petrochemical and petroleum industries. They can serve you as an extension of your own personnel or as a total service.

Catalytic has been instrumental in the development of many new processing techniques for the chemical and metallurgical industries. Among other things, our wide experience in the field of the moving bed process may help you with its new and varied applications—a versatile modern method for carrying out chemical and metallurgical operations. After the process design is developed, Catalytic is equipped to carry out mechanical design and to deliver and construct a facility. We welcome your inquiries.



Commercial Houdriflow catalytic cracking unit

CATALYTIC

CONSTRUCTION COMPANY

1528 WALNUT STREET, PHILADELPHIA 2, PENNSYLVANIA

In Canada: Catalytic Construction of Canada, Limited: Sarnia, Ontario

CATALYTIC *ON-TIME...ON-BUDGET* SERVICES for the metallurgical, chemical, petrochemical and oil refining industries

Project Analysis Process Development Process Design Economic Studies Engineering Procurement Construction Plant Operation

Tubing Selection for High Temperature Service



STRESS RUPTURE DATA ON B&W CROLOYS
AND OTHER TUBULAR MATERIALS FOR HIGH-TEMPERATURE SERVICE

MATERIAL	ANALYSIS, Per Cent	HEAT TREATMENT	TEST TEMP. (F)	STRESS, psi, to Cause Rupture in			LONGEST TEST, Hours
				1,000 Hours	10,000 Hours	100,000 Hours*	
MEDIUM CARBON STEEL	C .35 max; Mn .80 max; Si .10 min	Hot Rolled & Annealed	850	21,000	16,000	12,000	27,224
		Hot Rolled & Annealed	950	12,500	8,800	6,100	27,961
CROLOY 2¼	Cr 2.00-2.50; Mo .90-1.10	Annealed	1000	21,000	16,800	13,500	9,240
		Annealed	1100	13,600	10,000	6,200	29,286
		Annealed	1200	7,600	4,400	2,550	15,189
CROLOY 7	Cr 6.00-8.00; Mo .45-.65	Annealed	1200	5,900	4,300	3,100	3,106
		Annealed	1300	3,400	1,900	1,130	1,525
CROLOY 18-8 S (Type 304)	Cr 18.00-20.00; Ni 8.00-11.00	A	1050	33,200	24,500	18,000	11,858
		B	1050	35,000	23,000*	13,500	7,863
		A	1200	21,500	16,500	13,000	10,646
		B	1200	20,000	15,500	11,500	9,752
		S	1200	21,000	15,000*	10,500	7,474
CROLOY 18-8 Ti (Type 321)	Cr 17.00-20.00; Ni 9.00-13.00; Ti 5xC-.60	A	1050	42,000	34,000	26,500	16,944
		B	1050	40,000	31,000	24,000	8,063
		S	1050	39,500	30,500	23,500	7,119
		A	1200	23,500	16,000	11,000	13,507
		B	1200	24,000	16,000	11,000	9,935
CROLOY 18-8 Cb (Type 348)	Cr 17.00-20.00; Ni 9.00-13.00; Cb 10xC-1.00	A	1050	42,000	34,000	27,500	18,286
		B	1050	45,000	31,000	22,000	9,287
		A	1200	26,500	17,000	10,000	8,495
		B	1200	24,500	16,000	10,000	10,286
		S	1200	24,000	13,500	7,800	17,084
CROLOY 16-13-3 (Type 316)	Cr 16.00-18.00; Ni 11.00-14.00; Mo 2.00-3.00	B	1350	11,500	7,500	4,800	13,848
		S	1350	12,000	6,850	3,650	9,134
		B	1500	6,000	3,300	1,750	13,146
		S	1500	5,850	3,300	1,850	14,233
CROLOY 25-20 (Type 310)	Cr 24.00-26.00; Ni 19.00-22.00	A-1	1350	9,600	4,350	3,400	46,000**
		A-1	1500	4,800	2,500	1,000	6,310
		A-1	1650	2,650	1,000	240	10,083
		A-1	1800	1,375	500	180	10,080

NOTE: All tests from which these data were derived were held 24 hours at test temperature before applying stress.

Heat Treatment
- A — 2000 F for ½ hour then water quench
- A-1 — 1950 F for 1 hour then water quench
- B — 2000 F for ½ hour, water quench, then 1750 F for 1 hour then air cool
- S — 2000 F for ½ hour, water quench, then 1600 F for 5 hours then furnace cool

* Extrapolated.

** Tests have reached time indicated without rupture and are being continued.

Selecting the right tubing for high temperature service calls for consideration of temperature and pressure conditions, combined with a number of other specifics.

Mechanical strength may be the factor of first importance after operating temperature. In this case, the tensile strength of the tubing selected is most important. Though the mechanical strength of some steels decreases as temperatures rise, there are those that retain more of their strength at high temperatures. A case in point is the tensile strength of carbon steel tubing and B&W Croloy 18-8S (Type 304) at 300 F. Both have a tensile strength of about 70,000 psi. at this temperature. However, when the temperature is elevated to 1200 F, the tensile strength of carbon steel tubing is sharply reduced to about 12,000 psi. while Croloy 18-8S decreases to about 44,000 psi.

To evaluate the characteristics of metals operating under stress at high temperatures and over long periods of time, B&W has performed stress rupture tests and creep tests on a great number of alloy and stainless steels. The results of these tests help engineers to determine the proper tube to be used in specific applications. (See tables shown)

Other factors beside mechanical strength, however, must be considered in choosing the optimum tube for a specific high temperature application. Some of these factors are: oxidation resistance, size, cost, flow rates, and rates of conductivity and expansion.

It takes an expert to specify the right tube for any particular application, and there is no substitute for the kind of expert attention to these problems you'll find at B&W.

To get the most benefit from B&W's long experience in matching tubes to jobs, call on Mr. Tubes, your nearby B&W Tube Representative. He can help you make the best choice.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa. and Milwaukee, Wis.: Seamless Tubing, Welded Stainless Steel Tubing
Alliance, Ohio: Welded Carbon Steel Tubing
Milwaukee, Wis.: Seamless Welding Fittings



CREEP STRESS DATA ON B&W CROLOYS

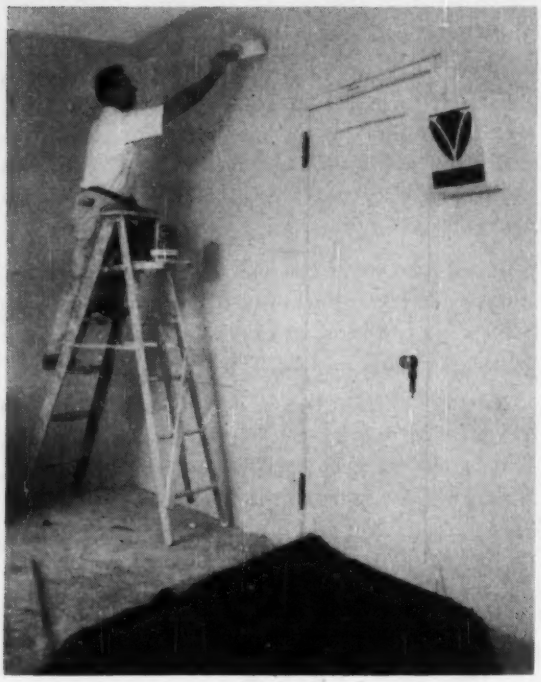
AND OTHER TUBULAR MATERIALS FOR HIGH-TEMPERATURE SERVICE

Creep Stress in lb. per Sq. In. for 1 Per Cent Elongation in 10,000 and 100,000 Hours

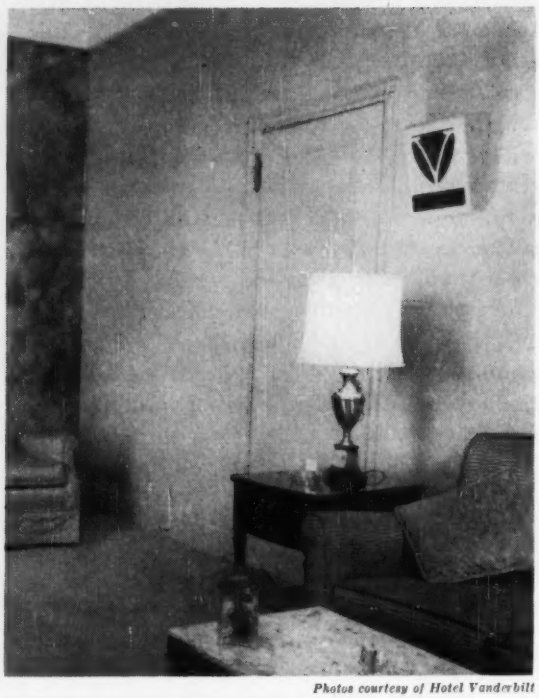
MATERIAL	ANALYSIS	800F	900F	1000F	1100F	1200F	1350F	1500F
	1% — 10,000 Hr. (0.1% — 1000 Hr.)							
CARBON STEEL, KILLED	0.10- 0.20% C; 0.25 max. Si	19,500	11,000	7,200	....	....	....	....
CARBON-MOLY, 0.50% MO.	0.10- 0.20% C; 0.45- 0.65% Mo.	33,500	24,500	12,400	....	....	....	....
CROLOY 1¼	1.00- 1.50% Cr; 0.45- 0.65% Mo.	....	35,000	14,700	5,500	3,375	....	....
CROLOY 2¼	2.00- 2.50% Cr; 0.90- 1.10% Mo.	....	40,500	16,350	9,200	4,175	....	....
CROLOY 5	4.00- 6.00% Cr; 0.45- 0.65% Mo.	....	17,900	9,200	4,800	1,800	....	....
CROLOY 7	6.00- 8.00% Cr; 0.45- 0.65% Mo.	....	14,500	8,000	4,400	2,000	....	....
CROLOY 9M	8.00-10.00% Cr; 0.90- 1.10% Mo.	....	33,250	12,000	6,950	2,300	....	....
CROLOY 18-8S (Type 304)	18.00-20.00% Cr; 8.00-11.00% Ni	....	24,000	18,300	11,550	6,600	2,500	....
CROLOY 16-13-3 (Type 316)	16.00-18.00% Cr; 11.00-14.00% Ni; 2.00-3.00 Mo	....	....	22,800	13,800	8,200	4,200	1,840
CROLOY 25-20 (Type 310)	24.00-26.00% Cr; 19.00-22.00% Ni	....	....	....	....	7,400	3,300	1,100
	1% — 100,000 Hr. (0.01% — 1000 Hr.)							
CARBON STEEL, KILLED	0.10- 0.20% C; 0.25 max. Si	13,500	8,400	2,150	....	....	....	....
CARBON-MOLY, 0.50% MO.	0.10- 0.20% C; 0.45- 0.65% Mo.	23,500	17,200	5,200	....	....	....	....
CROLOY 1¼	1.00- 1.50% Cr; 0.45- 0.65% Mo.	....	20,000	8,200	2,125	910	....	....
CROLOY 2¼	2.00- 2.50% Cr; 0.90- 1.10% Mo.	....	22,000	7,600	4,910	2,510	....	....
CROLOY 5	4.00- 6.00% Cr; 0.45- 0.65% Mo.	....	15,000	7,200	2,400	900	....	....
CROLOY 7	6.00- 8.00% Cr; 0.45- 0.65% Mo.	....	9,200	5,000	2,500	1,300	....	....
CROLOY 9M	8.00-10.00% Cr; 0.90- 1.10% Mo.	....	24,750	8,500	3,775	1,600	....	....
CROLOY 18-8S (Type 304)	18.00-20.00% Cr; 8.00-11.00% Ni	25,300	18,000	11,500	7,100	4,250	1,600	....
CROLOY 16-13-3 (Type 316)	16.00-18.00% Cr; 11.00-14.00% Ni; 2.00-3.00 Mo	....	....	14,800	8,700	5,000	2,500	930
CROLOY 25-20 (Type 310)	24.00-26.00% Cr; 19.00-22.00% Ni	....	....	....	....	5,400	2,800	800

Values for Croloys 1¼ to 9M inclusive are for 0.15% carbon maximum alloys.

TA—5040 (P)



MORNING: Acrylic paint goes on.



Photos courtesy of Hotel Vanderbilt

AFTERNOON: Room ready for occupancy.

Acrylics and PVAc Eye Water Paint Trade

Make no mistake, water-thinned paints are here to stay now that newer, better emulsions are available to further excite a public fancy first caught by rubber latex.

The provocative merits of water emulsion paints—fast dry and quick recoating properties, ease of application (and cleanup) and mild odor—have established a permanent niche for them.

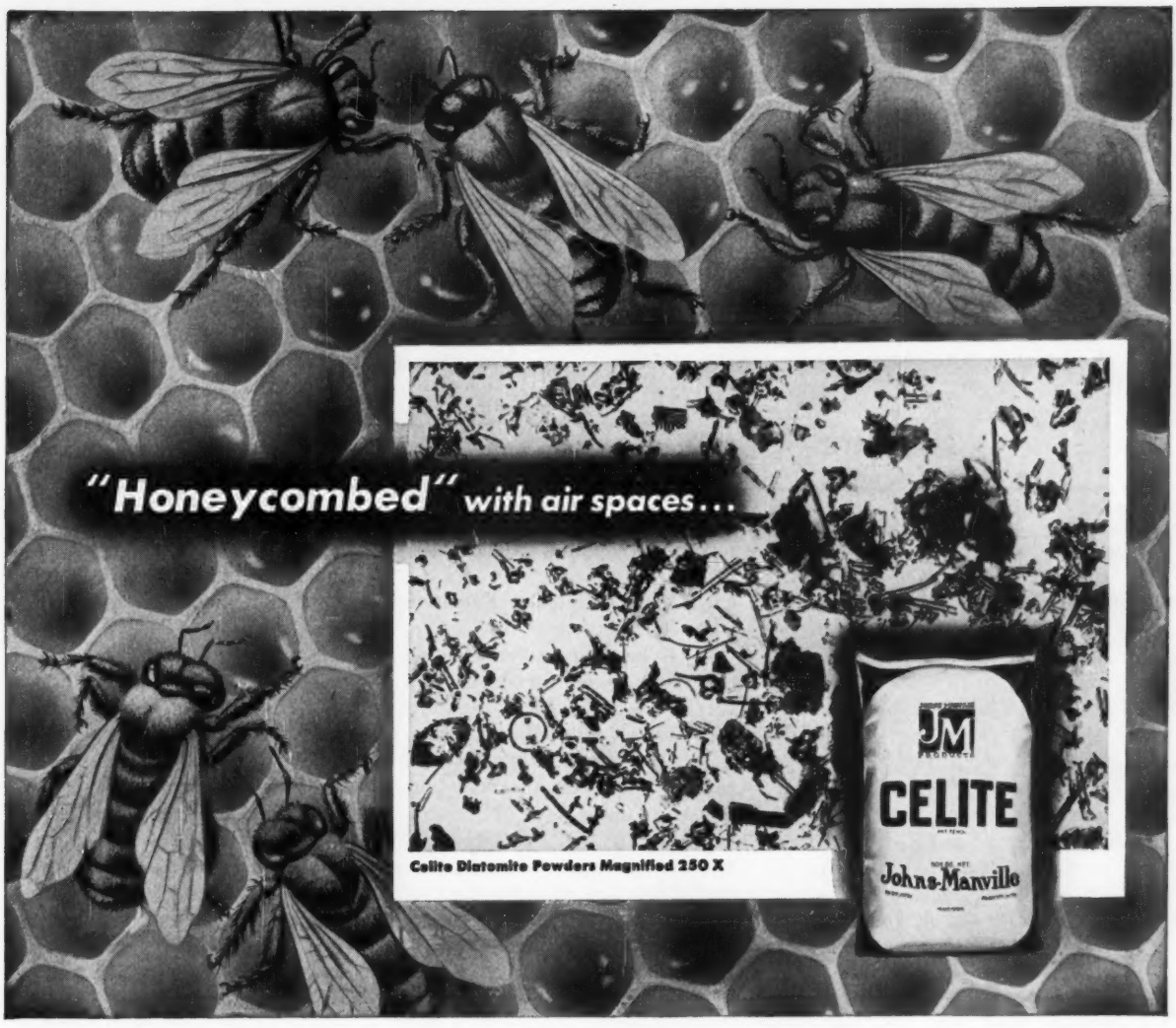
However, their first champion, rubber latex (styrene/butadiene), the bulldozing emulsion resin that smoothed the way to consumer acceptance of water paints and carried them almost overnight to a 40 million gallon sales level in 1953, shows signs of having set the pace as long as it can.*

Rubber latex lost much of its momentum in the face of stiffening resistance from solvent paints, headed up now by odorless alkyds. That it is hard pressed now to hold its gains and will certainly slip considerably in the next few years is not due so much to the activity of its first competitor, the solvent paint. The pressure comes, rather, from the newer type water emulsions—acrylic, polyvinyl acetate, vinyl-vinylidene copolymer and polystyrene. All these are clamoring for the attention of the paint manufacturer looking for new and better water paints to woo the consumer and broaden the total market for emulsion paints. Today, all indications are that this Lothario will be either a PVAc emulsion or its newer competitor, acrylic resin emulsion paint.

Big guns behind the sales drive for these newer products are quite naturally the resin emulsion manufacturers. Dupont, with its "Elvacet 81-900" emulsion, National Starch Products, Borden Co.'s Polyco Dept. and Colton Chemical, to name a few, are pushing PVAc. Rohm & Haas, with Rhoplex AC-33, and Borden are behind the acrylics.

► **Latex Drawbacks**—For, despite the current success of rubber-based paint, manufacturers and consumers alike recognize that certain of its properties could stand improvement. These are, from the manufacturer's standpoint, the necessity of avoiding hard water which

* 1954 sales of all emulsion paints are figured at no more than 50 million gal.



Celite Powders provide bulking action

3 to 10 times greater than any other inert mineral filler

POUND FOR POUND, Celite* diatomite powders supply more bulking action than any other inert mineral filler because their cubic volume is 3 to 10 times greater. Celite's unique "honeycombed" structure is composed of microscopic, irregularly shaped particles that won't pack down. In mass they weigh only about 10 lbs. per cubic foot.

That's why Celite is so widely used to add bulk and body to industrial formulations. For example, it extends white pigments in paints and papers . . . it improves dispersion of insecticides and fertilizers . . . it fluffs up dry powders such as household cleansers.

Also, from Celite's "honeycombed" structure comes its great absorptive capacity. This characteristic is profitably utilized to keep powders free-flowing . . . to provide a medium for shipping or storing liquids in dry form. And because of the physical structure of its individual particles, Celite has become the outstanding flatting agent for paints . . . it serves as a mild, non-scratching abrasive for fine polishes . . . it improves the surface appearance of plastics.

Which of the many Celite advantages can you use to build product performance or cut costs? A Johns-Manville Celite Engineer will gladly discuss your problem, without obligation. For his services or more information, write Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay St., Toronto 1, Ontario.

*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS **Johns-Manville CELITE** INDUSTRY'S MOST VERSATILE MINERAL FILLER

Newsworthy chemicals this month

Up and coming water emulsion paints....140A
Silica gel dries natural gas.....144A
Tougher, heat resistant polyethylene.....144B
Isosebacic acid.....146A
Silicones waterproof roads.....146B
Fermentation chemicals.....148A
New synthetic musk.....148B
Wash-fast acetate dyes.....148C
Acrylate-type elastomer.....148D
Nylon fiber from caprolactam.....148E
Low-density cracking catalyst.....148F
Silicone carbide refractory.....148G
Two-phase protective oils.....148H
Industrial rayon.....148I
Non-ionic detergent.....148J

Page number is also Reader Service code number

For more about any item, use Reader Service

might interfere by breaking the colloid; inability to use calcium sulfate pigments; and the demanding and rigorous manufacturing techniques required. From the consumer's point of view, latex's inherent disadvantages are yellowing and embrittlement of the paint film with age; poor freeze thaw stability; inadequate initial washability; poor water resistance.*

Both acrylic and PVAc emulsion paints minimize or correct many of these drawbacks and do so without sacrifice to all the desirable features of styrene/butadiene water-thinned paints. It is, however, in correcting these shortcomings of original latex emulsions that the two products diverge and it is this degree of divergence that must eventually decide which one—acrylic or PVAc—will go furthest in replacing latex as the favorite.

▶ **Drying Time**—Both materials are considered fast drying paints. Under normal conditions as to temperature and humidity, acrylics are dry and ready for recoating in 20-30 min. PVA paints are a trifle slower, usually requiring 1-2 hr. Either product, however, allows painters to apply two coats in one day. This feature makes it possible to apply two coats of paint without moving expensive scaffolding, thus reducing painting costs. In the case of hotels, offices or other institutions, this means minimum disruption of business and no lost rental time.

▶ **Color and Whiteness Retention**—It is in this category that acrylics really shine. Their color retention and clarity is unmatched even in the presence of high temperature, high humidity and ultra-violet rays. In addition, acrylic white is, to all practical purposes, non-yellowing, indoors or out.

▶ **Washability**—All field and laboratory tests to date report that the washability and stain resistance of a properly formulated and properly applied acrylic film rates on a par with good quality synthetic semi-gloss or gloss enamels. In addition, this washability is attained within an hour after application. Good washability and stain resistance is also claimed by the manufacturers of PVA paints as soon as the paint is thoroughly dry (usually overnight), while maximum wet-rub resistance is developed in about a week.

▶ **Water Permeability**—Films of both acrylic and PVA emulsions have the unusual characteristic of high moisture vapor transmission and yet are resistant to the passage of liquid water. As a result, these paints can be applied successfully over surfaces which have not dried sufficiently to permit application of conventional paints. For exterior work, this feature makes the painter less dependent on weather.

▶ **Water Sensitivity**—PVA films are inherently water-sensitive and under certain conditions are susceptible to water spotting. It is most noticeable with colored paints, particularly deep colors. Attempts at cross-linking polymer chains and modification of the PVA emulsion with cyclopentadiene-modified linseed oil show promise of lessening this condition. However, only limited exposure data are available on formulations of this type. Acrylics, on the other hand, have excellent water resistance and will not exhibit film softening on exposure to water.

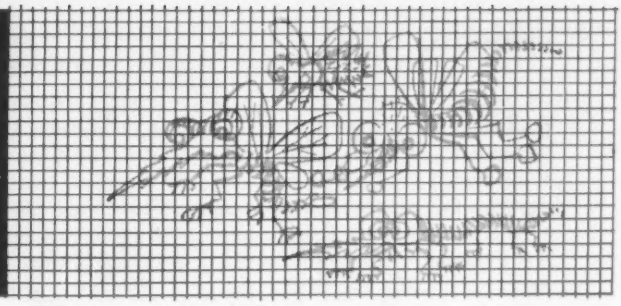
▶ **Application**—Both products have a mild "non-painty" odor which rapidly dissipates on drying, are easily applied by conventional means and exhibit good adhesion over a variety of interior and exterior surfaces such as concrete, plasterboard, plaster, cement-asbestos shingles, wood, primed metal, etc. PVA films, however, will not properly form at temperatures below 50°F., while acrylic films can be applied on very humid days and even in cold weather, as long as the temperature is a few degrees above freezing. Valuable for "hot" uses, too, acrylic paints can be applied to radiators, for they don't get brittle or smell when heated.

▶ **Versatility**—The principal use of PVA paints to date has been for exterior masonry and more recently as a primer-sealer. Manufacturers now hope that they can also secure a share of the interior market. Water based acrylic emulsions, however, are not only suitable as primer-sealers and interior and exterior finishes, but have been successful as baking metal primers.

▶ **Price Rub**—There appears to be little question of acrylic's superior-

* It should be stated in all fairness that many of these drawbacks may be lessened by proper formulation—especially freeze thaw stability. However, any additional precautions and operations required of the formulator cost him both time and money.

STOP SPOILAGE BY MOLDS AND BACTERIA...



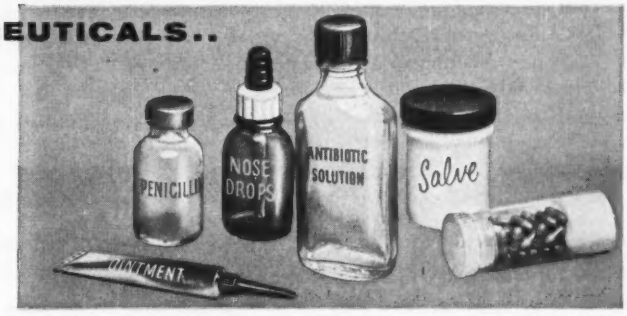
Heyden PARASEPTS®

(ESTERS OF PARAHYDROXYBENZOIC ACID)

IN POLISHES, WAXES, PASTES, GUMS..



IN PHARMACEUTICALS..



IN TOILETRIES..



If your product is among the many that are subject to mold and bacterial attack, it will pay you to investigate the Parasepts as preservatives. These colorless and practically odorless neutral esters combine the properties of effectiveness, stability and safety, and have long served in a wide variety of products.

Our sales and technical staffs will be glad to discuss your prospective use. Write or phone the nearest sales office for full information and samples.

METHYL PARASEPT
Purified
(Methylparaben U.S.P.)

PROPYL PARASEPT
Purified
(Propylparaben U.S.P.)

ETHYL PARASEPT
Purified

BUTYL PARASEPT
Purified

BENZYL PARASEPT
Purified

Technical grades also available for industrial applications. 100, 50, 25 lb. fiber drums.

HEYDEN
CHEMICAL CORPORATION

342 Madison Avenue, New York 17, N. Y.

Chicago • Cincinnati • Detroit • Philadelphia • Providence • San Francisco

FINE HEYDEN CHEMICALS

Benzaldehyde • Benzoic Acids • Benzyl Chloride • Beta-Oxynaphthoic Acid • Chlorotoluenes • Creosotes • Formaldehyde • Formic Acid • Guaiacols Parahydroxybenzoates • Pentaerythritols • Propyl Gallate • Resorcinol • Salicylates • Salicylic Acid • Sodium Benzoate

ity over the rubber latex paints marketed today. In fact, many spokesmen for the paint trade think that, pound for pound, acrylics give the best over-all performance of any emulsion resin, require less tinkering by the formulator to be made suitable for difficult jobs.

But here's the rub. Acrylic paint resins cost more—as much as 8¢ a lb. more than rubber latex and PVAc resins. Despite several price cuts by Rohm & Haas, acrylics manufacturer—a total of 5¢ a lb. or 20¢ per gallon of paint—since the resin's introduction in 1953, and the recent competition afforded by Borden's Polyco Dept. (formerly the American Polymer Co.), the newest acrylic emulsion maker, resin prices remain high. Only expanded use, and possibly fresh competition among present and potential acrylic suppliers, can lower those prices.

▶**No Lagging**—Premium or no, acrylic emulsion paint does appear to be catching on. One of the leading manufacturers of acrylic paints, Maintenance Coatings Co., of New York, says its Macrylic Plastic Coating has been widely accepted by the hotel industry as well as the hospital and institutional field.*

Maintenance's method of marketing had been to sell the institutional trade directly or through factory-agents, thereby decreasing distribution costs. Sales have been good even in areas where acrylics cannot compete price-wise with conventional finishes. Maintenance attributes this to the properties of acrylic paint which, by easing the bane of all hotels, lost rental time, more than mitigate its higher first cost.

They believe, too, that institutions have come to realize that material rarely exceeds 25% of the total cost of a painting job, for they appear willing to invest in a slightly more expensive paint to reap the reward of longer and more durable service.

▶**Wanted: Promotion**—But acrylic paint must somehow also court the 30 million homeowners believed to be doing their own painting. It is these "do-it-yourself" enthusiasts—the group that put styrene-butadiene latex paint in its present position—that must be sold before acrylics can become big business.

Without active merchandising by the larger paint manufacturers—Montgomery Ward is the only big maker, today, of acrylic paint—whose potent purchasing power is needed to effect emulsion price cuts and whose powerful promotional agencies are capable of reaching the consumer, acrylics will remain a specialty item at a specialty price. That this broadside promotion will come very soon is debatable.

For the steady increase in total sales of the paint industry over the past six years has been due, in no small part, to the increased popularity of rubber latex paints. Millions of dollars have been spent in advertising them. Millions more remain invested as inventory on dealers' shelves. All this will be considered by industry giants before acrylics get the promotion which, by virtue of their properties, they deserve. **140A**

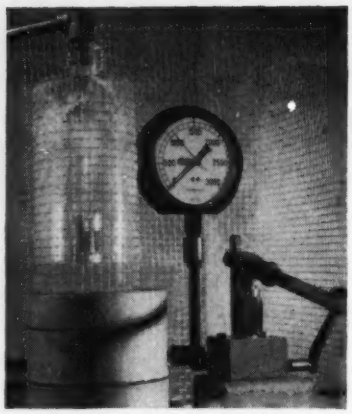
* Four big New York hotels—Roosevelt, Vanderbilt, Commodore and New Yorker—use Maintenance's acrylic paint, the first two on an exclusive basis.

Natural Gas Drier

Pre-attrited type silica gel economically dehydrates natural gas.

Natural gas is dehydrated to about 7 lb. of water per million cu. ft. to prevent hydrate formation which clogs lines, to decrease corrosion, to reduce power costs for compression. In more than a year of field testing at United Gas Pipe Line's Carthage, Tex., plant, a coarse granular, pre-attrited silica gel has dried wet gas to an average dew point of less than −14 F. The gel is available at a price which, it's said, makes its use economical.

The special silica gel's activity held up well, starting at 22% and leveling off at about 11% after twelve months of use. And it resisted breakdown, as shown by a constant pressure drop through the dehydration towers.—**Davison Chemical Co., Baltimore 3, Md.** **144A**



Tough Polyethylene

Koppers is first with a product based on much-discussed Ziegler low pressure reaction.

"We're just about fifteen minutes ahead of the field." That statement was made at a recent Koppers press conference unveiling a new kind of polyethylene made by a low pressure polymerization process, a polyethylene that's tough, rigid, heat resistant and glossy-surfaced.

And those few candid words express pretty well the hectic scramble among firms to be the first to get a Ziegler-based product on the market. For, at least nine U. S. companies are known to "have had a look" at the Ziegler patents. Some have said they like what they see so much that they intend to produce polyethylene by this method.

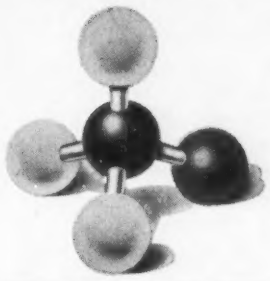
Now one of these firms, Koppers, has bridged the gap between a "reaction in glassware" to a feasible process and claims to be the first to announce availability of a low pressure product—called Super Dylan—for evaluation. In a big hurry to gain that "fifteen minute" jump on the pack, Koppers took little more than six months to go from their first look at the reaction to their product announcement. Substantial quantities of Super Dylan polyethylene are reaching plastic fabricators this month with finished products expected by early fall.

▶**Big Appeal**—What intrigues the polyethylene makers investigating the new process is not primarily

SOLVAY

METHYL CHLORIDE

from the world's newest, most modern plant, backed by Solvay's reputation for quality



Check these Physical Properties of Solvay Methyl Chloride

Formula	CH_3Cl
Molecular Weight	50.49
Boiling Point	−23.7°C. • −10.65°F.
Freezing Point	−97.6°C. • −143.7°F.
Specific Gravity liquid 20/4°C.	0.918
gas 0°C. 760 mm. (air = 1)	1.74
Pounds per Gallon Liquid at 20°C. (4.83 atm.)	7.5
Coefficient of Cubical Expansion (Liquid) Avg. 0° to 40°C.	0.0022/°C.
Vapor Density at B.P. (760 mm.)	2.47 g./liter
Refractive Index Liquid $N_D^{23.7}$	1.3712
Viscosity Liquid (20°C.)	0.24 centipoise
Surface Tension (in air) 20°C.	16.2 dynes/cm.
Specific Heat Liquid (20°C.)	0.382 cal./g./°C.
Gas (25°C. 15 psia)	
Cp	0.199 cal./g./°C.
Cv	0.155 cal./g./°C.
Latent Heat of Vaporization (At B.P.)	102.3 cal./gm.
Critical Temperature	143.1°C. • 289.6°F.
Critical Pressure	65.9 atm.
Flash Point	Below 0°C.

Solvay Methyl Chloride meets the traditional Solvay high standards of quality and purity. This means that you can depend on it whether you use it as a catalyst carrier in low-temperature polymerizations, a refrigerant, a coolant, a solvent, an extractant for highly heat-sensitive products, a propellant in high pressure aerosols, or as a methylating agent in the production of plastics, intermediates or dyes.

If you have any questions regarding the use of Solvay Methyl Chloride in your operations—write us and we will be glad to send you additional data. For FREE 26-PAGE BOOK on Solvay Chloromethanes, or information on a specific problem, fill out and mail the coupon below.

GET ALL THE FACTS — MAIL COUPON NOW!

SOLVAY PROCESS DIVISION
ALLIED CHEMICAL & DYE CORPORATION
61 Broadway, New York 6, N. Y.

—BRANCH SALES OFFICES:—
Boston • Charlotte • Chicago • Cincinnati • Cleveland • Detroit
Houston • New Orleans • New York • Philadelphia • Pittsburgh
St. Louis • Syracuse

Soda Ash • Caustic Soda • Caustic Potash • Chlorine
Potassium Carbonate • Sodium Bicarbonate • Calcium Chloride
Cleaning Compounds • Ammonium Chloride • Sodium Nitrite
Snowflake® Crystals • Ammonium Bicarbonate • Chloroform
Ortho-dichlorobenzene • Monochlorobenzene • Methyl Chloride
Para-dichlorobenzene • MethyleneChloride • CarbonTetrachloride

SOLVAY PROCESS DIVISION
Allied Chemical & Dye Corporation
61 Broadway, New York 6, N. Y.

Gentlemen:
Please send me—AT NO COST OR OBLIGATION:
☐ Your new book on Methyl Chloride and other Solvay Chloromethanes
☐ Additional information—see attached letter

Name _____
Company _____
Title _____
Address _____
City _____ Zone _____ State _____ DR-7

the prospects of a low pressure (nearly atmospheric) process—which may or may not be much more economical than conventional 3,500 psi. operation—but, rather, the unusual plastic properties that can result, properties which fit polyethylene for jobs it couldn't do before except, perhaps, through irradiation.

There are reasons, however, for dismissing irradiated polyethylene as competition per se to Super Dylan. While it's freely admitted that radiation can impart properties equal and superior to low pressure poly there's some question whether it can do so economically. And assuming radiation treatment becomes less expensive—which it will—the new poly, already the possessor of many "irradiated" features, e.g. heat resistance, presents a better jumping off place for irradiation. In other words, equal properties with less irradiation.

▶ **Tough and Tear-Proof**—Stickout feature of the new poly is its surprising rigidity and tensile strength. A 1-in. Super Dylan pipe withstands more than 1,000 psi. pressure (regular poly blows at about 400 psi.), suffers less than a 2-in. (compared to usual 5 or 6) deflection under a one pound weight, takes a 32 psi. impact in an Izod Impact Tester after being chilled to −78 F.

Super Dylan's high tensile strength promises better poly film for packaging—tear strength is 2-3 times that of regular poly—a market already chewing up more than 70 million lb. a year of poly film. Super Dylan permits one third the vapor and liquid diffusion rate of ordinary polyethylene. Also, Ziegler-process poly has less tendency to block (stick together), thus will be easier to run off in packaging machines.

Another compelling property is heat resistance which extends polyethylene's useful temperature range 30 F. and more. New poly can be steam-cooked at 250 F. without sacrifice to appearance or utility.

▶ **Glamour, Too**—Better looking, too, is the new plastic, with a smooth, glossy surface quite unlike polyethylene's usual waxy look and feel—a big factor in customer appeal. Colored products are thus rendered more brilliant.

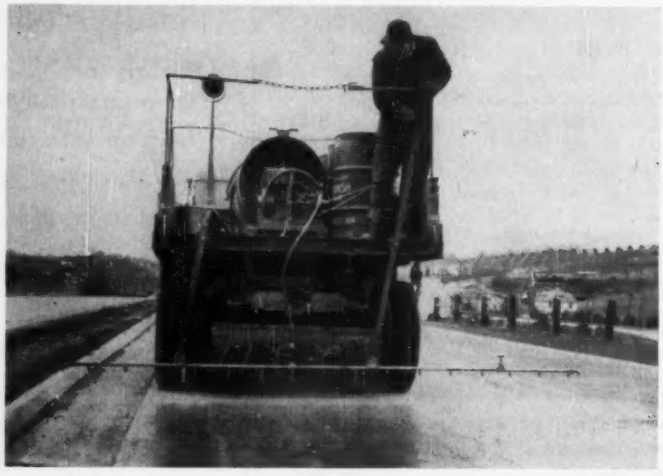
Super Dylan's initial price is 43¢ a lb.—2¢ higher than conventional polyethylene.—**Koppers Co., Inc., Pittsburgh 19, Pa.** 144B

Isosebacic Acid

Used in synthetic jet lubes it beats sebacic acid price-wise and adipic acid, quality-wise.

A mixture of sebacic acid isomers, tradenamed U.S.I. Isosebacic Acid, has the properties to ease government concern over possible short supplies of castor-oil-derived sebacic acid in wartime. The government, as a matter of fact, has turned to less desirable adipic acid as a basis for synthetic jet lubricants rather than cast its lot with sebacic.

Priced at 45¢ a lb., Isosebacic Acid is more than competitive with sebacic (64¢ a lb.), is within striking distance of adipic (37-38¢ a lb.) and is a good bet, in general, for many jobs calling for a C_6-C_{12} dibasic acid: production of vinyl resin plasticizers with low volatility, non-migration and low temperature properties; production of polyamides; synthesis of polyurethane resins; imparting flexibility and water resistance to alkyd resin coatings; production of polyesters for reinforced plastics, etc. U. S. I. Isosebasic Acid is a mixture of α ethyl suberic acid (72-90%), α, α' diethyl adipic acid (12-18%) and sebasic acid (6-10%).—**U. S. Industrial Chemicals Co., New York 16, N. Y.** 146A

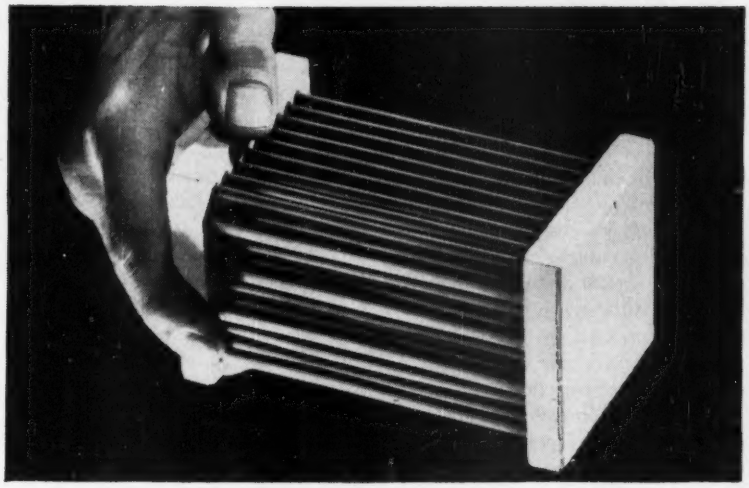


Silicones Take to the Open Road . . . and Vice-Versa

"Everywhere" is the word for silicones. Their latest venture—field application to 1,000 yd. of concrete highway test area (see cut)—has won them the sizable job of treating all bridge decks carrying New York State Thruway traffic.

General Electric thinks silicones should, by waterproofing concrete surfaces, materially lessen long range highway maintenance costs. Untreated concrete exposed to freeze-thaw cycles may fail by spalling, particularly in the presence of salt chemicals used for ice control.

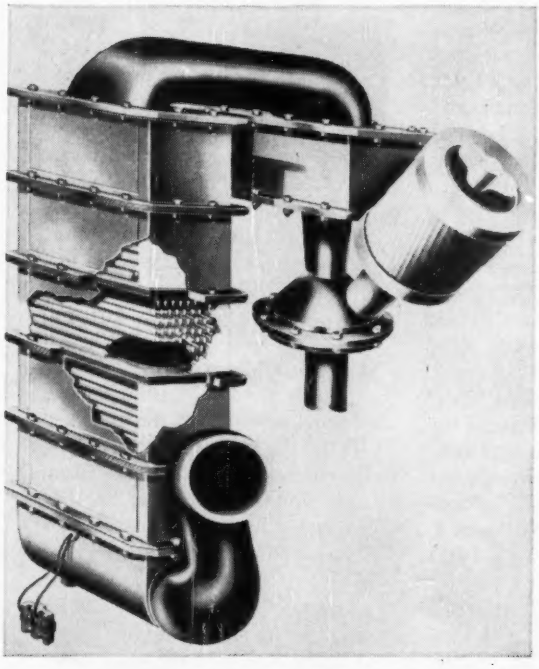
Silicone spraying doesn't make concrete surfaces slippery even during or after rainfall. On the contrary, silicone-treated concrete—because it doesn't darken-by-wetting on exposure to water—is more visible to motorists in rainy weather.—General Electric Co., Pittsfield, Mass. 146B



This new combustion catalyst, the oxycat, controls air pollution and creates energy and power by recovering waste heat. Porcelain rods (by Frenchtown Porcelain Company, Frenchtown, N.J.) are largely made of ALCOA Alumina to provide high resistance to thermal and mechanical shock. Rods are coated with a catalytic agent of ALCOA Activated Alumina and platinum.



In typical installations, oxycats are mounted in exhaust stacks of furnaces, drying ovens, incinerators, or any industrial processes where combustible gases are exhausted. Waste gases flow across rods. Combustion occurs at catalytic surface. Heat released by this exothermic reaction can be returned to the oven, converted to steam or used in other processes. Catalyst removes practically 100% of pollutants from gas streams.



Oxy-Catalyst catalytic exhaust, working on the same principle, ends dangerous exhaust fumes and odors from internal combustion engines. Made to take the place of standard mufflers, OCM is easily installed in gasoline, diesel or LPG-powered equipment.

Now ALCOA ALUMINA turns exhaust gases into energy instead of smog

Oxy-Catalyst, Inc. of Wayne, Pa., has put ALCOA Alumina to work eliminating air pollution and inefficient combustion, all in one operation.

In their new oxycat and OCM exhausts, ALCOA Alumina is part of the porcelain rods and catalytic coating. Used in the porcelain because it is highly inert and chemically stable, ALCOA Alumina does not interfere with the chemical reaction of the catalyst. In the coating, ALCOA® Activated Alumina provides extremely active oxidation maintained over a wide range of temperatures. It is very resistant to poisoning and highly efficient over a long period of time.

ALCOA Aluminas are remarkably versatile wherever they are used . . . with hundreds of applications in catalysis, desiccation, refractories and ceramics. Put ALCOA Aluminas to work *for you*. Write for samples of alumina to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-G Alcoa Building, Mellon Square, Pittsburgh 19, Pennsylvania.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

Fermentation Chemicals

Four more chemicals based on fermentation products make debut.

Close on the heels of a March announcement of volume availability of fermentation-produced itaconic acid—and in line with its "fermentation chemical-a-month program"—Pfizer brought forth two citric acid ester plasticizers in April and two itaconic acid esters in May.

• Aceytl tributyl citrate (Citroflex A-4) and acetyl tri-2-ethylhexyl citrate (Citroflex A-8) are odor-free, high-boiling plasticizers available in volume. A-4 (not a new chemical but with a new virtue—it's odorless) has a low toxicity (FDA-accepted), is soluble in most organic solvents. It's recommended for use in heat and light-stable polyvinyl chloride films, cellulose-based lacquers and in formulations with polyvinyl acetate, polyvinyl acetals and polyvinylidene chloride. Price: 33¢ a lb.

A-8, with low volatility and good low temperature flexibility, is a specialty plasticizer for producers of PVC and polyvinylidene chloride polymers and copolymers.

• Dimethyl itaconate and dibutyl itaconate—highly reactive esters available in pilot plant quantities. Both esters copolymerize readily with acrylonitrile, methacrylate, vinyl chloride, styrene and butadiene. A double bond adjacent to, rather than between, two ester groups makes the itaconates particularly interesting in the preparation of complex compounds. Copolymers of dimethyl itaconate with styrene, or one of the methacrylates, yield clear, water-white materials with excellent optical properties.—**Chas. Pfizer & Co., Inc., Brooklyn 6, N. Y.** 148A

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Briefs

New synthetic musk that's not a nitro or macrocyclic type but a cyclic ketone is Versalide. A pure chemical individual derived from domestic, readily obtainable raw materials, this perfume base is claimed superior to the nitro musks and on a par with more expensive macro-cyclic muskes. Versalide is completely stable, does not cause discoloration of soaps and cosmetics.—**Givaudan-Delawanna, Inc., New York 36, N. Y.** 148B

Eastofix acetate dyes have, it's claimed, a wash fastness heretofore unequalled while retaining high fastness to light and gas fading. Use of dyed acetate yarn —now as wash-fast as vat-dyed cotton—will expand in such fields as draperies, upholsteries and sportswear.—**Eastman Chemical Products, Inc., Kingsport, Tenn.** 148C

An acrylate-type elastomer, Vyram, resists both petroleum and ester-based hydraulic fluids and ozone. Vyram is easily fabricated, using conventional equipment, into standard packings and gaskets. It may also find use as a hose liner, wire coating and impregnant for specialty fabrics requiring chemical resistance. Development quantities are available.—**Monsanto Chemical Co., St. Louis 4, Mo.** 148D

Nylon 6 fiber, based on the new polyamide from caprolactam (Chem. Eng., p. 144, June, 1955), is said to take deep color dyes better than other synthetic fibers. Thus you can get two or more separate colors with a single dye bath by using the two types of nylon, 6 and 66, alone or together with Dacron, which dyes still differently.—**National Aniline Div., Allied Chemical & Dye Corp., New York 6, N. Y.** 148E

Low-density petroleum cracking catalyst combines attrition resistance—usually sacrificed for low density—with inherent advantages of higher stability of surface area, pore volume and catalytic activity under operating conditions.—**Davison Chemical Co., Baltimore 3, Md.** 148F

Thin silicone carbide refractory withstands 3,000 F. under load conditions without warping or cracking. The new refractory is said to be a space and fuel saver because (1) thickness required to carry a load is reduced, thus affording greater setting area and (2) heat it more available to fire products rather than the supporting refractories.—**Electro Refractories Abrasives Corp., Buffalo, N. Y.** 148G

Two-phase rust-proofing protection of internal metal surfaces in closed or semi-closed systems is possible with a series of preservative oils called Nucle-oils. Nucle-oils combine protective properties of inhibited oils with those of oil-soluble, volatile rust inhibitors. The latter vaporize from the oil to protect surfaces above oil level.—**Daubert Chemical Co., Chicago 1, Ill.** 148H

Industrial rayon fiber, designed to fill the gap between high tenacity rayon on one side and glass fiber and industrial steel wire on the other, is Fortisan-36. Available now in 800 denier continuous filament (heavier deniers are expected), Fortisan-36 is qualified for use in power transmission belting, high pressure hose, conveyor belts, etc. Price: $1.50 a lb.—**Celanese Corp. of America, New York 16, N. Y.** 148I

Non-ionic detergent, called CF-10, is tailored for use in formulations where conventional detergents may not be satisfactory due to excessive foam or suds. Possessing good detergent properties and chemical stability, CF-10 is a low foamer even at high concentrations and vigorous agitation.—**Rohm & Haas Co., Philadelphia 5, Pa.** 148J

NO LEAKAGE
NO CONTAMINATION
NO STUFFING BOX

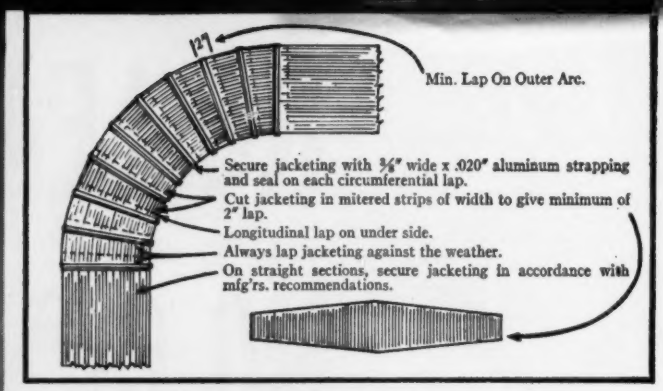


Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

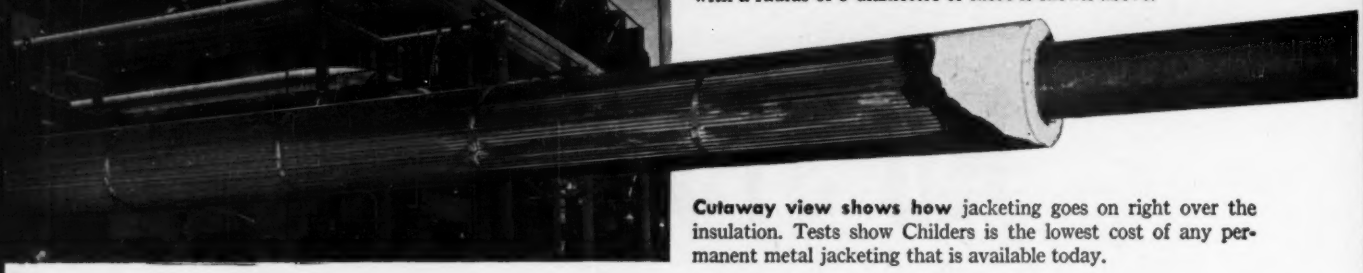
Lapp Pulsafeeder is a combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only a hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from the working pump parts—eliminates need for stuffing box or running seal. Pumping speed is constant; variable flow results from variation in piston-stroke length—controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 471 Wilson St., Le Roy, N.Y.*

Lapp



New method of applying aluminum jacketing over pipe bends with a radius of 5 diameters or more is shown above.



Cutaway view shows how jacketing goes on right over the insulation. Tests show Childers is the lowest cost of any permanent metal jacketing that is available today.

Only pliers and pocket knife needed to apply easy-to-handle Childers Aluminum Jacketing



Best method of applying jacketing is with aluminum strapping and seals. Other method is to use sheet metal screws.



Aluminum strapping can be pulled tight enough with just pliers. Lugs are then bent over and fastening is complete.

Eastern States Petroleum's two-man crew covers insulated lines, even L's and bends—using light-weight, weatherproof aluminum jacket.

Childers Jacketing for insulated lines, made of .006" 3S alloy aluminum, was used to cover thousands of feet of line in Eastern States Petroleum's Houston plant.

As it does in over 1000 other plants in all 48 states and many foreign countries, Childers Jacketing helped save Eastern States many expensive hours of application and maintenance time.

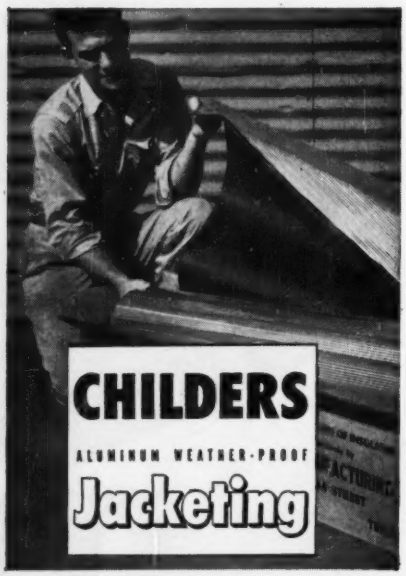
In fact, tests show this: Two men, working with Childers Jacketing for the first time, can cover more feet of insulated line in a day than with practically any other kind of covering. This means real savings in application costs.

The cost is low, too. You can actually put aluminum jacketing on your lines for less than the cost of the cheapest weatherproofing when one paint job is considered.

Immediate shipment from our large factory stocks can eliminate costly delays in construction or plant improvement schedules.

Try this low cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. Address: Childers Manufacturing Company, Department CE-12, 3620 West 11th Street, Houston, Texas.

Engineering representatives in most cities to work with you on jacketing problems.



Childers Jacketing arrives on the job in convenient rolls 4 feet wide and 100 feet long—easy for one man to handle. Jacketing comes with or without a moisture barrier attached to the back of the .006" aluminum. Rolls are well protected for field storage if kept dry. Boxes light enough for one man to carry. (Adv.)

Only 1 way to buy

Formaldehyde

—order from

NITROGEN DIVISION

8

You can order Formaldehyde of highest purity in EIGHT different concentrations from Nitrogen Division.

Get the concentration meeting your needs—inhibited or low methanol—from one of the largest producers of Formaldehyde for industrial use.

Ask for technical assistance to help you find just the right concentration for your particular process. Ask too, for samples and quotations!

Choose from these 8 concentrations:

37% Low Methanol
37% Inhibited (6%-7% Methanol)
37% Inhibited (10%-15% Methanol)
44% Low Methanol
44% Inhibited
45% Low Methanol
50% Low Methanol

also

U.F. Concentrate—85

NITROGEN DIVISION ALLIED CHEMICAL

Use U.F. Concentrate—85 to Produce Urea Resins!

59% Formaldehyde—26% Urea
A total of 85% active ingredients!
Makes costs go down.
Increase kettle charge.
Decrease cycle time.
Pay no more than for less concentrated forms.

NITROGEN DIVISION

ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
Hopewell, Va. • Ironton, Ohio • Orange, Tex. • Omaha, Neb.

Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate
Methanol • Urea • Ethanolamines • Ethylene Oxide • Ethylene Glycols
Formaldehyde • Nitrogen Tetroxide • Nitrogen Solutions • U.F. Concentrate—85
Fertilizers & Feed Supplements

APPLETON

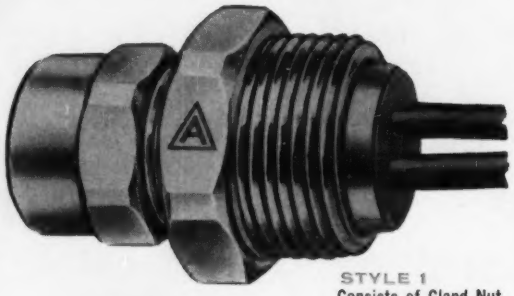
Entirely New!

"MI" Series Connectors* for simplified installation of Safety Mineral Insulated Cable

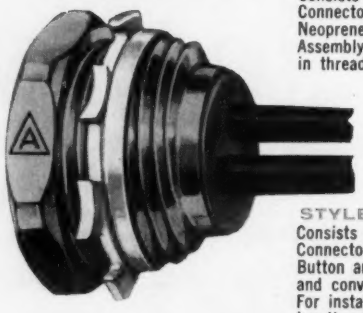
Fewest Components . . . No Messy Compounds!
No Maintenance . . . No Wire Pulling!

You can speed up the job and *save money* on Mineral Insulated cable installations by specifying these new APPLETON "M.I." Series Connectors*. Threaded Hub Style has *only three* brass components . . . Knockout Style has *only one!* Simplified design makes for easier installation . . . eliminates sealing compound *every time*. Precision milled and threaded solid brass fittings positively exclude moisture and water, oil, chemical and acid fumes, and dirt from the electrical system and assures positive grounding. In addition, the *extra* quality built into each APPLETON "M.I." Connector preserves the efficiency of Mineral Insulated Cable and assures you of absolute reliability of performance. Write for Bulletin TMI-455 today.

*PATENT PENDING

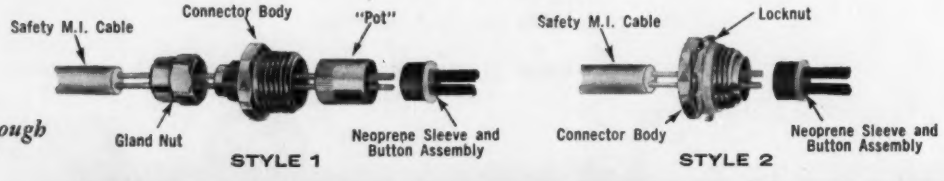


STYLE 1
Consists of Gland Nut, Connector Body, "Pot", and Neoprene Button and Sleeve Assembly. For installation in threaded conduit hubs.



STYLE 2
Consists of self-tapping Connector Body, Neoprene Button and Sleeve Assembly and conventional Locknut. For installation in steel junction box knockouts.

Simplified Design . . . Easy Assembly



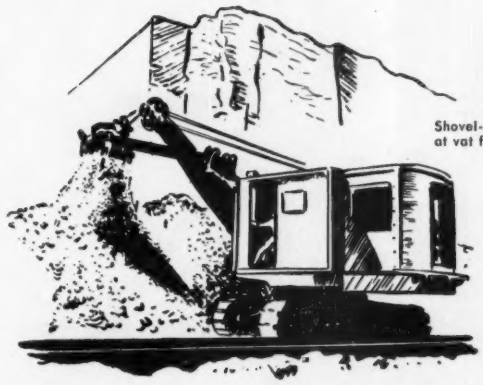
Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
1742 Wellington Avenue • Chicago 13, Illinois

Also Manufacturers of:



Rely on APPLETON *. . . The Standard for Better Wiring*



Shovel-loading at vat face.

Crude Sulphur

for Industrial Use

from the properties of

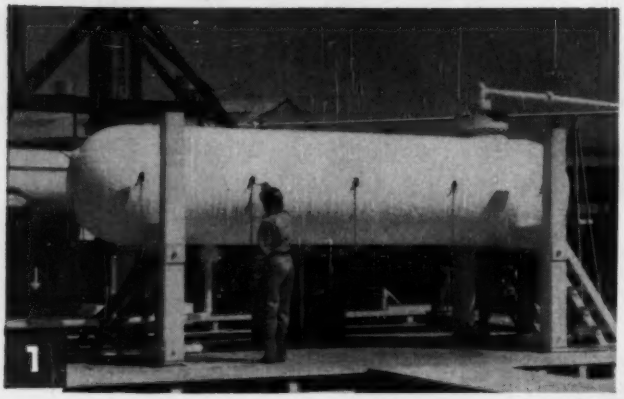
Texas Gulf Sulphur Co.

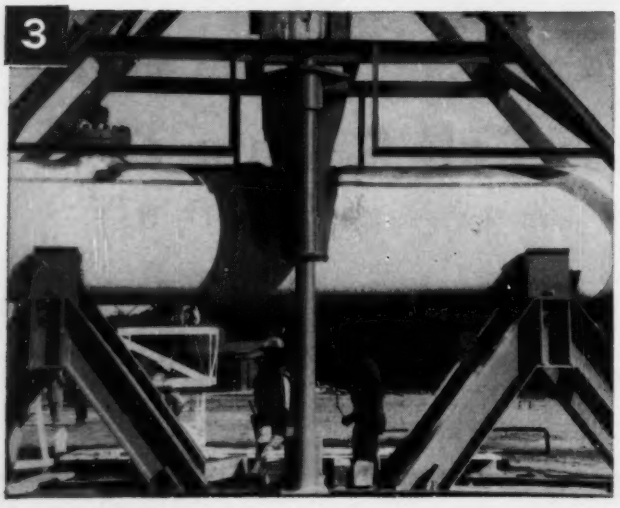
75 East 45th Street • New York 17, N. Y.

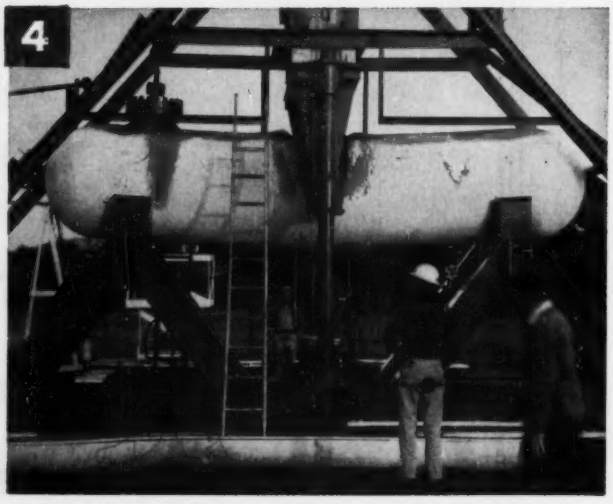
Producing Units

- **NEWGULF, TEXAS**
- **MOSS BLUFF, TEXAS**
- **SPINDLETOP, TEXAS**
- **WORLAND, WYOMING**

FROZEN STEEL







STAYS TOUGH!

Even at 38° below zero

new USS "T-1" Steel withstands impact of 2,000,000 ft. lbs.

YOU can count on your fingers the few materials that will withstand high impacts at sub-zero temperatures. You have an equally tough time finding more than a handful of materials that will hold up in *high* temperature, high stress applications. But new USS "T-1" Steel does *both* – that's what makes this new engineering material so very remarkable.

"T-1" Steel stays tough and durable at temperatures far below zero, yet remains strong at temperatures as high as 900° F. What's more, you get this unique combination of properties in a steel that is easy to fabricate, that can be welded or flame-cut without pre- or post-heating.

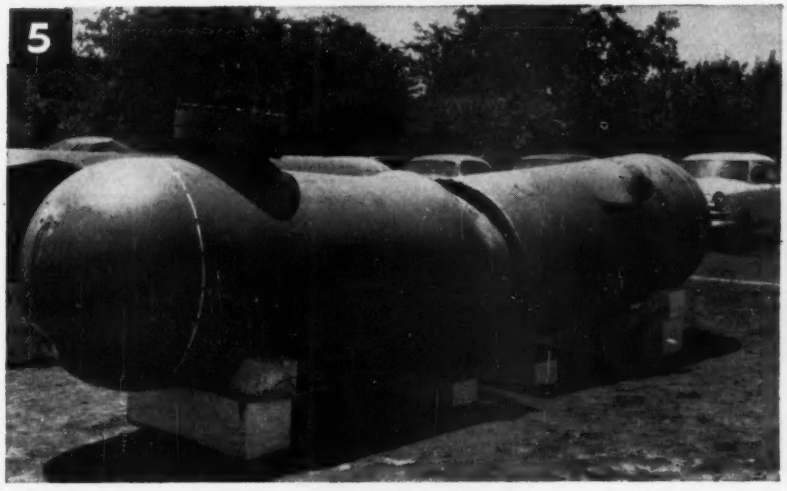
Here is proof of what USS "T-1" Steel can do. Last summer, four-welded pressure vessels made of half-inch "T-1" Steel plate were tested to destruction. Two vessels were stress relieved; two were not stress relieved after welding. Each vessel was refrigerated to temperatures far below zero, then pressurized so that the stress in the steel was 90,000 psi. (Photo #1) That stress alone is enough to rupture the average pressure vessel—it is *five times* normal design strength. But that's only the point at which *testing began* on these "T-1" Steel vessels.

A 13-ton steel ingot was raised high above the vessel . . . then dropped, repeatedly, until the vessel failed. The first drop from 52 feet knocked off the frost (Photo #2), but that's all. The steel and every weld remained intact, and the top of the vessel was barely dented. (Photo #3)

The second drop from 73 feet socked the vessel with an impact of 2,000,000 ft. lbs. at a temperature as low as –38° F. But the blow merely increased the dent another fraction of an inch. The steel held and the vessel was still sound. (Photo #4)

The third and final drop from 101 feet caused failure. With the 13-ton ingot striking at a speed of 55 miles per hour, the steel *had* to give. But it *didn't shatter* or show any sign of brittleness. It stayed tough and ductile. (Photo #5)

As a result of these tests, several major pressure vessel fabricators have requested approval from the ASME to use USS "T-1" Steel in unfired pressure vessels because . . .



HERE'S WHAT USS "T-1" STEEL CAN DO

You can use new USS "T-1" Steel to build larger pressure vessels and storage tanks . . . to use higher allowable working pressures in vessels that weigh no more than present designs.

With no pre- or post-heating required, you can fabricate vessels either in the shop or the field—whichever is more convenient and less costly. Remember, too, when you use the high strength of "T-1" Steel to reduce the thickness of welded sections, you cut welding time and the amount of welding rod needed.

Lighter weight construction with "T-1" Steel reduces shipping, handling, and material costs – and reduces the cost and weight of any foundations and supports that might be needed. Write for complete information.

UNITED STATES STEEL CORPORATION, PITTSBURGH
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION
WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

USS

UNITED STATES STEEL

Photo courtesy of Eimco Corp.



The right fabric adds efficiency to continuous operation

Probably better than any other, the chemical and processing industries know the importance to filtration of fabrics "engineered" for the job.

We know it, too. Consider the filtration of coal slimes in continuous vacuum filters, for instance. Supplying the correct fabric construction means more than just assuring continuity of operation.

It means adding efficiency and a higher rate of flow through a well-made, well-fitted fabric that avoids blinding—assures easier cake discharge.

But your problem is different? Of course, it is. Why not talk it over with one of the leading filtration specialists who distribute our fabrics? See what type of Wellington Sears cotton or synthetic might help solve it.

We will be glad to supply the names of distributors, together with a free copy of "Filter Fabric Facts"—illustrated booklet on filter fabric development and application.

Wellington Sears

A Subsidiary of West Point Manufacturing Company

FIRST In Fabrics For Industry

Wellington Sears Company,
65 Worth Street, New York 13, N. Y.

Offices in: Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

Only Ingersoll-Rand Chemical Pumps offer you the exceptional

CORROSION RESISTANCE

of IRCAMET

This special alloy steel, developed for chemical pumps, easily handles a wide range of corrosive solutions ...from sulphuric acid to caustic soda!

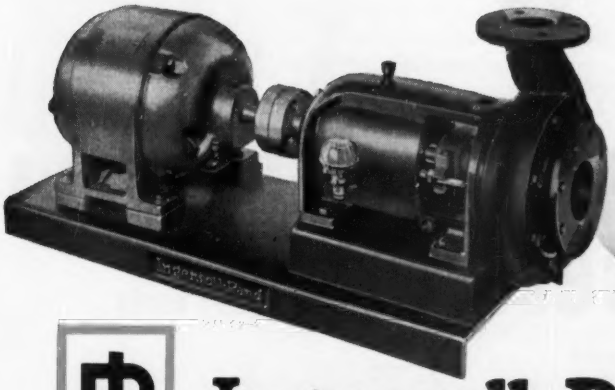
Na_2CO_3 NH_3 H_3PO_4 H_2SO_4 NaCl NaOH CH_3COOH

The ability of I-R chemical pumps to withstand such a wide range of strong corrosive solutions is the result of years of metallurgical research—both in the laboratory and in the field.

All parts of the pump that come in contact with the liquid are made of IRCAMET – a high nickel-chromium-molybdenum alloy steel, specially developed for chemical pump service.

The problem of *leakage*, too, has been successfully solved by a patented LEAKOLLECTOR stuffing box gland that completely encircles the shaft and stuffing box. In addition, all I-R chemical pumps can be supplied with a packless CAMERON SHAFT SEAL that requires practically no attention or maintenance.

These performance-proved I-R chemical pumps are available in sizes from ¼ to 125 hp, with capacities from 10 to 4000 gpm. For complete information, write for Bulletin No. 7095-A. Or if you have a pumping problem of any kind, just call your nearest Ingersoll-Rand representative. He will be glad to help you.



CH_3COOH NaOH NaCl NH_3 H_2SO_4 H_3BO_4 Na_2CO_3

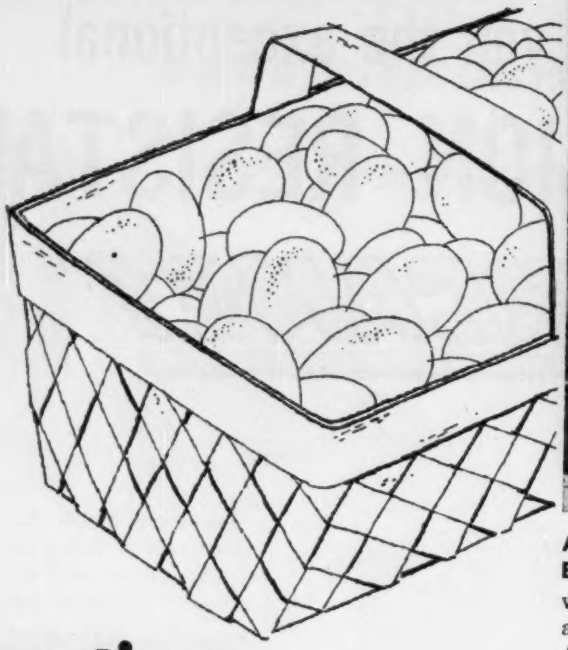
Ingersoll-Rand

10-204

Cameron Pump Division
11 Broadway, New York 4, N. Y.

PUMPS • CONDENSERS • TURBO-BLOWERS • COMPRESSORS • AIR & ELECTRIC TOOLS • ROCK DRILLS

Capsule Case History:





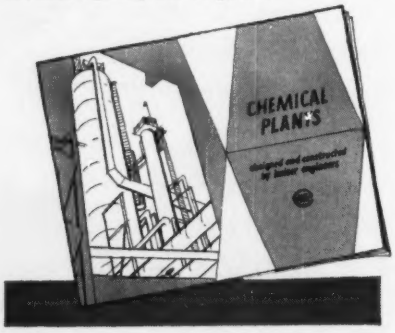
A New Diatomaceous Earth Processing Plant
was delivered by Kaiser Engineers as a single package project to one of America's largest producers of diatomite products. This project, from preliminary layouts, through design, engineering, procurement and construction was delivered to the client as an operating unit.

The KE team of engineering specialists is staffed and equipped to build your new chemical plant or to expand existing facilities.

Write today. A new KE chemical processing brochure (No. 101) will be mailed upon your request.

Sometimes it pays...

Kaiser Engineers, a close-knit team of specialists, is staffed to handle every phase of your project. Their work in widely divergent fields of design and construction offers plenty of proof that it pays to put all your project eggs in this one basket.



kaiser engineers...*for low operating costs*

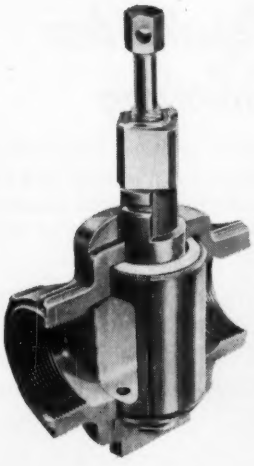
DIVISION OF HENRY J. KAISER COMPANY

ENGINEERS KE CONTRACTORS

• HOME OFFICE: KAISER BUILDING, OAKLAND 12, CALIFORNIA (CABLE: KAISENGS) NEW YORK, PITTSBURGH, WASHINGTON, D.C.
• HENRY J. KAISER CONSTRUCTION CO. • HENRY J. KAISER COMPANY (Canada) LTD., MONTREAL • KAISER ENGINEERS INTERNATIONAL, INC.



But how open?



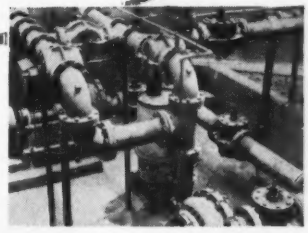
Only as "OPEN" as the valve's port opening! If the opening is smaller than the pipe ...then a valve cannot be COMPLETELY "OPEN" in any position!

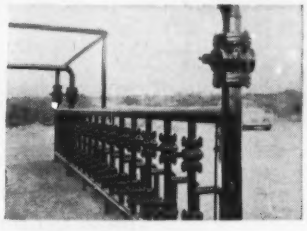
For a really "OPEN" flow...specify **acf** Rectangular Port Valves. With a port opening the same area as the pipe itself...they assure smooth-running, trouble-free operation by keeping down turbulence and harmful abrasive action caused by solids in suspension. They also minimize loss of head pressure...especially important when handling the extra heavy fluids used in the processing industries.

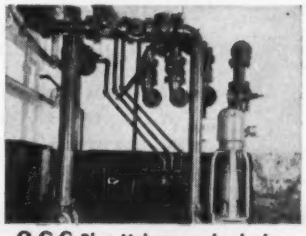
And, of course, all **acf** *Cylindrical* Lubricated Plug Valves...with rectangular or round port openings...feature "split-second" shut off, TEFLON* head gaskets, and many other design advantages. Representatives in 50 Principal Cities.

Write for descriptive Catalog 7-CM
acf Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan.

*DUPONT TRADENAME



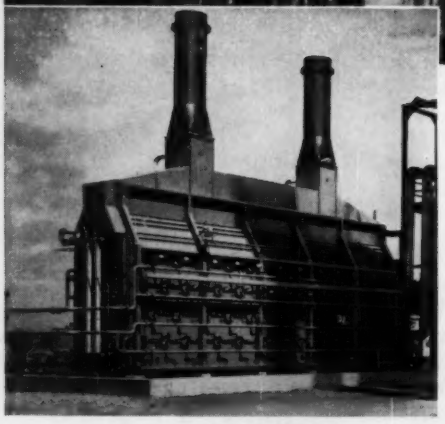




acf Plug Valves are backed up by Proof-of-Performance in every Processing Industry.

acf CYLINDRICAL FULL PIPE AREA **PLUG VALVES**





Multiple Coil Heating Cuts Costs ...is More Efficient..Requires Less Space For Catalytic Reforming

Zone control of Selas Gradiation Heaters permits independent operation of more than one coil in a single radiant setting. Sun Oil Company takes advantage of this feature in the 3-coil Houdriforming unit at its Sarnia, Ontario, plant in the making of high octane gasoline. Installations of this type can provide:

Compact heating units with multiple coils and absolute temperature control in a single radiant chamber . . . Flexibility in shaping the heating curve . . . Complete combustion with little or no excess air . . . Prolonged tube life—lower maximum tube wall temperature, through more uniform circumferential heat distribution . . . Rapid response, with ± 1° F. temperature control.

Selas Gradiation Heaters are currently in operation in most of the major catalytic reforming processes. Where two or more process streams require separate heating you'll find it worthwhile to investigate Selas Gradiation Zone Control. Write for new bulletin on selection of heaters.

SELAS FLUID PROCESSING

CORPORATION OF AMERICA • PHILADELPHIA 34, PA.

The USS Forrestal—

another example of how Walworth helps protect a 200 million dollar investment

Walworth products installed aboard the *USS Forrestal* include gate, globe, and lubricated plug valves and pipe fittings. They are used on high pressure air lines, fire mains, and most of the other piping systems throughout the ship.

Thousands of Walseal® Bronze Valves, Fittings, Flanges, and Unions comprise the major portion of the Walworth installations.

Walseal is a registered trade mark which identifies valves and fittings manufactured by the Walworth Company. Walseal products have *factory-inserted rings* of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

WALWORTH

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

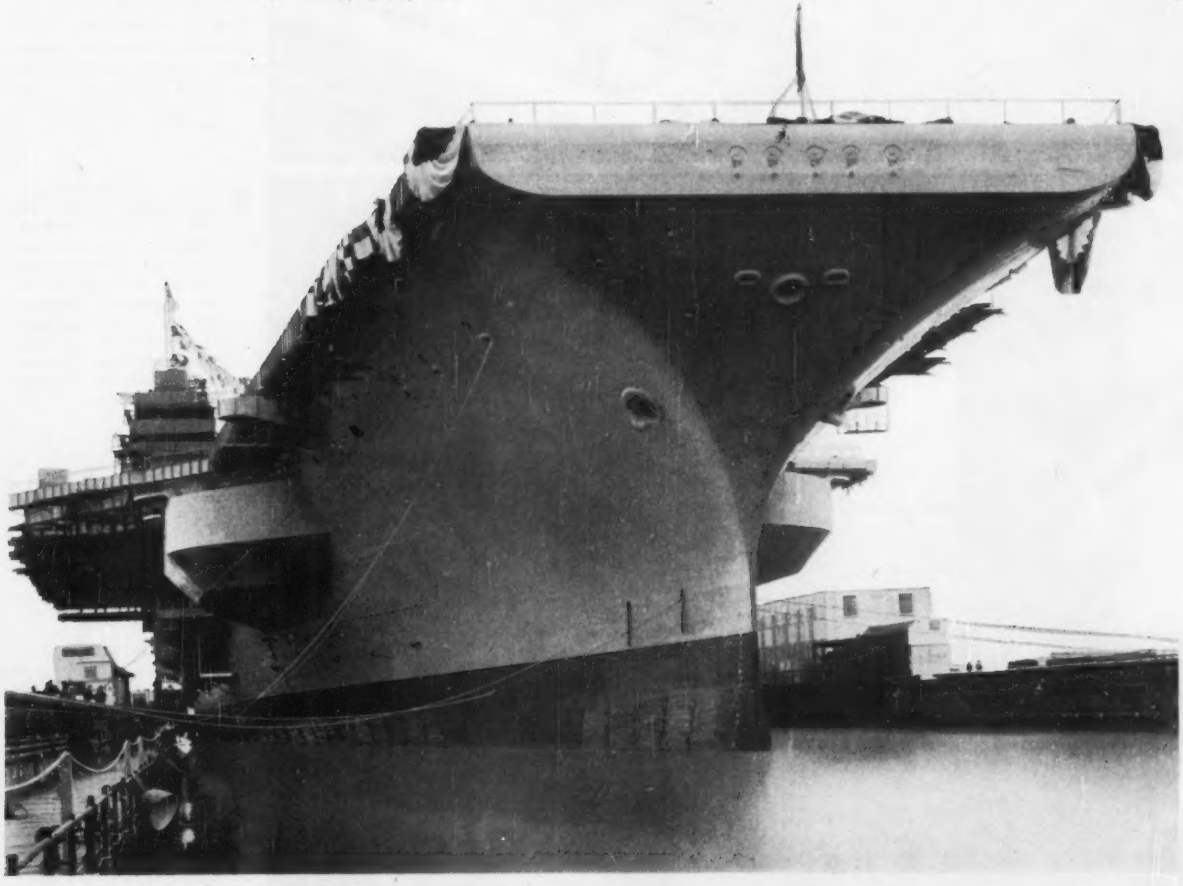
Walworth Company of Canada, Ltd., Toronto

Keel laying to launching—Walworth was there.

Walworth engineers worked with designers, metallurgists and builders of the mighty flat-top right from the blueprint stage. Their efforts assured the builder – Newport News Shipbuilding and Dry Dock Company – that *every* Walworth Valve and Fitting installed would meet *every* specification right down to the finest detail.

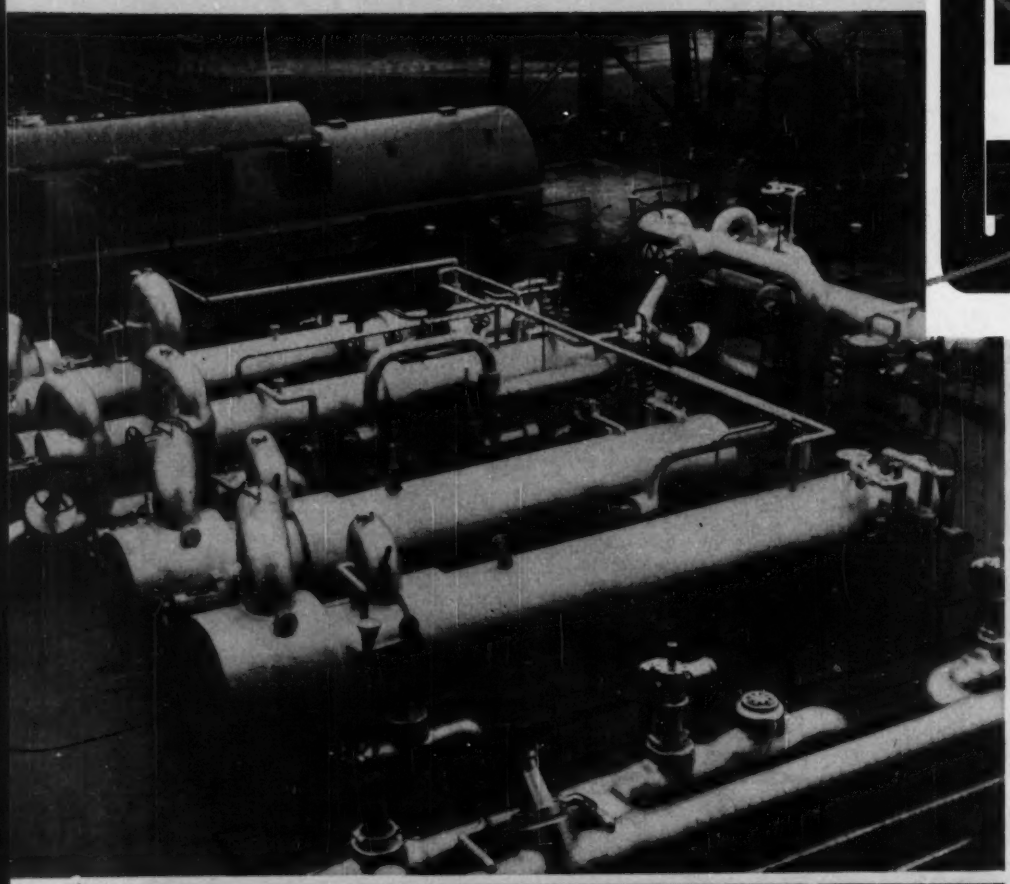
The *Forrestal* – like the *USS Nautilus*, the first nuclear-powered submarine – is another striking example of where Walworth engineering and products were called upon to protect a multimillion dollar investment.

Walworth, backed by 113 years of practical valve experience, is skilled in every type of installation. Whatever the industry, if your problem concerns valves or fittings, it will pay you to call on Walworth! Distributors in principal cities throughout the world.



One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

GPE



Griscom-Russell feed water heaters in a 125,000 KW public-utility power station; save nearly 100 tons of coal per day. Heaters handle flow of water exceeding 2000 G.P.M. at 2500 pounds pressure and steam extracted from the turbine at five different points; "train" of five units preheats water fed to boilers from 90° F. to 441° F.



Askania multiple fuel boiler control panel in large steel plant; maintains metered proportion between combustion air and fuels—coke oven gas and fuel oil—for most economical combustion; holds steam pressure constant through all load changes and keeps furnace pressure at a safe and predetermined value.



General Precision Laboratory's Industrial TV Camera, the "Bullet"; portable, easily operated; used to monitor and improve manufacturing processes and to view hazardous industrial operations.

The highly advanced technological products designed and manufactured by the eighteen producing companies of General Precision Equipment Corporation serve more than a dozen major industries. Products of six of these GPE Companies—Griscom-Russell, Askania, Librascope, Link, Kearfott and General Precision Laboratory—have widespread application in the processing and power industries.

Industrial Processing...and Power

The Griscom-Russell Company is one of the country's largest producers in the fields of heat exchange and water distillation. It is the pioneer in heat exchanger equipment—the key to the whole complex of modern industrial processing and power. For over seventy years, G-R equipment has been responsible for greatly increased efficiency and lowered operating costs in industry.

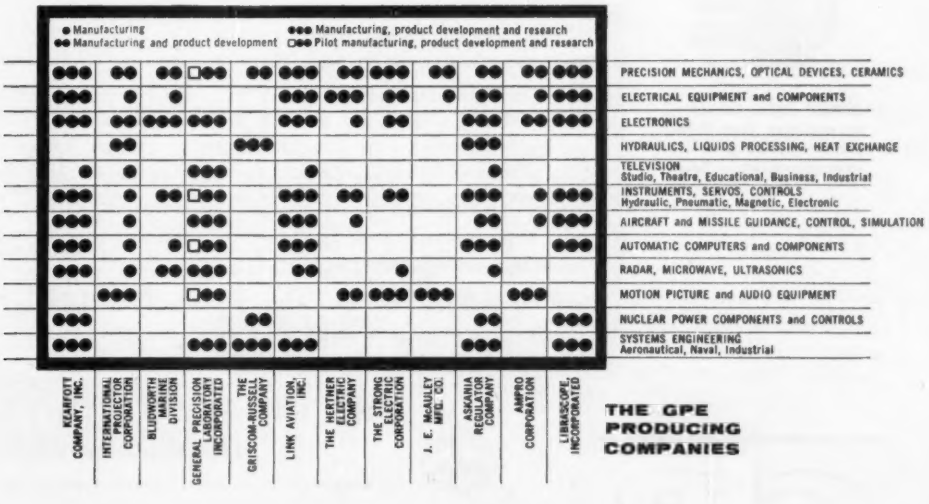
Askania Regulator Company for a quarter of a century has been a leading developer in the field of regulators and controls, including components and systems. Its products are widely used by the power, steel, gas and coke, mining, chemical, petroleum, glass and paper industries—wherever great reliability and accuracy are essential.

Kearfott Company, Inc.; Librascope, Incorporated; and Link Aviation, Inc. produce a wide variety of precision instruments, computers, servos and other control components for equipment and systems used throughout the power and the processing industries. Industrial television equipment manufactured by General Precision Laboratory Incorporated, the sixth GPE Company active in these fields, is playing increasingly important roles in "seeing eye" monitoring operations in these industries.

Each company in the GPE Group works in specific, highly specialized technical areas, as indicated in the chart below. Each of these companies, in addition to specializing in its particular products and fields of technical competence, has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation is achieved through GPE's basic operating policy, Coordinated Precision Technology.

In the fields of research and development, GPE Coordinated Precision Technology permits a high degree of specialization in particular areas of competence and supplements such specialization by the application of techniques in other fields, as desirable. In the field of production, it makes possible a highly flexible application of facilities. This policy has been responsible for a diversified line of precision equipment of superior design and performance, covering a wide range of both standard and special uses.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment, and of solutions to the underlying technical problems, are not restricted or distorted by traditional allegiance to specialization in a particular field. GPE coordination permits the engineers and technical personnel of each GPE Company to seek the optimum solution for the customer within the total capacities of the GPE Companies as a group.



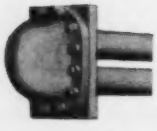
A brochure relative to GPE Coordinated Precision Technology and the work of the GPE Companies is available. Address your request, or inquiries on specific problems, to:

General Precision Equipment Corporation

92 GOLD STREET, NEW YORK 38, NEW YORK



Proved by 350,000 Years of Service

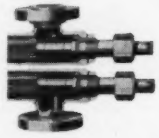


DOMED SHELL COVER—an exclusive Twin G-Fin Section feature provides streamlined return flow

More than 70,000 installed G-R Twin G-Fin Sections with an average operating period of well over 5 years have totaled a length of service which far exceeds that of any other sectional design of heat exchanger.

And what has this unique record demonstrated? It has conclusively proven the effective design and lasting construction of these units, originated by Griscom-Russell more than 25 years ago. It has also shown that the Twin G-Fin Section is the *universal* heat transfer apparatus—operating with complete success as a cooler, heater, condenser and heat exchanger for a wide range of fluids. And it has provided Griscom-Russell with an unequalled experience and wealth of performance data that assure the most authoritative recommendations and reliable ratings on this type of unit.

Write for Bulletin 1400 describing the G-R Twin G-Fin Section in detail.



3-PART END CLOSURE—an exclusive feature of Twin G-Fin Sections—far superior and simpler than in any other design of sectional unit

G-R
HEAT TRANSFER APPARATUS

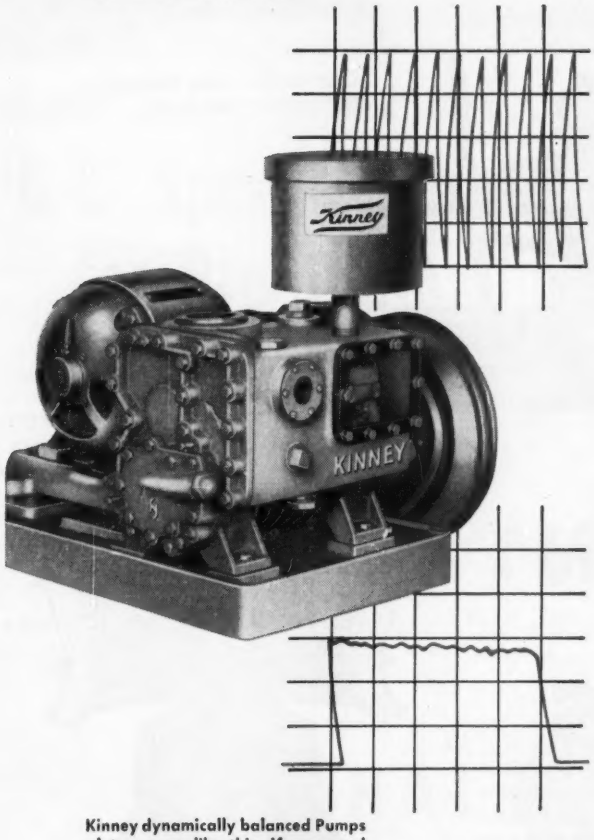
THE GRISCOM-RUSSELL CO.
MASSILLON, OHIO
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

Twin G-Fin Section

346

We took the *V* out of vacuum!

Here's the kind of curve an ordinary vacuum pump plots on a vibragraph. This might be called "nerve-shattering" performance.



Kinney dynamically balanced Pumps plot a curve like this. If you need vacuum, balanced performance is another reason why you need Kinney.

Vibration, that is. Yes, the complete line of Kinney Compound High Vacuum Pumps, now dynamically balanced, is functionally vibration-free . . . another big plus for Kinney:

Ideal for Portable Jobs — Balanced performance is vitally important on light flowing vacuum jobs — and also on cabinet-enclosed installations.

Easier Installation, Less Maintenance — No need for flexible tubing to isolate pump from piping. Less vibration also means longer life for connecting piping, fittings, valves, etc.

Write us today for information of Kinney Balanced Compound Vacuum Pumps—and also about conversion kits for gaining vibration-free performance from Kinney Pumps now in use. Kinney Manufacturing Division, Boston 30, Mass. District offices in Boston, New York, Philadelphia, Cleveland, Chicago, and Los Angeles are all competently staffed to discuss vacuum with you. Los Angeles office carries complete stock and has full service facilities.

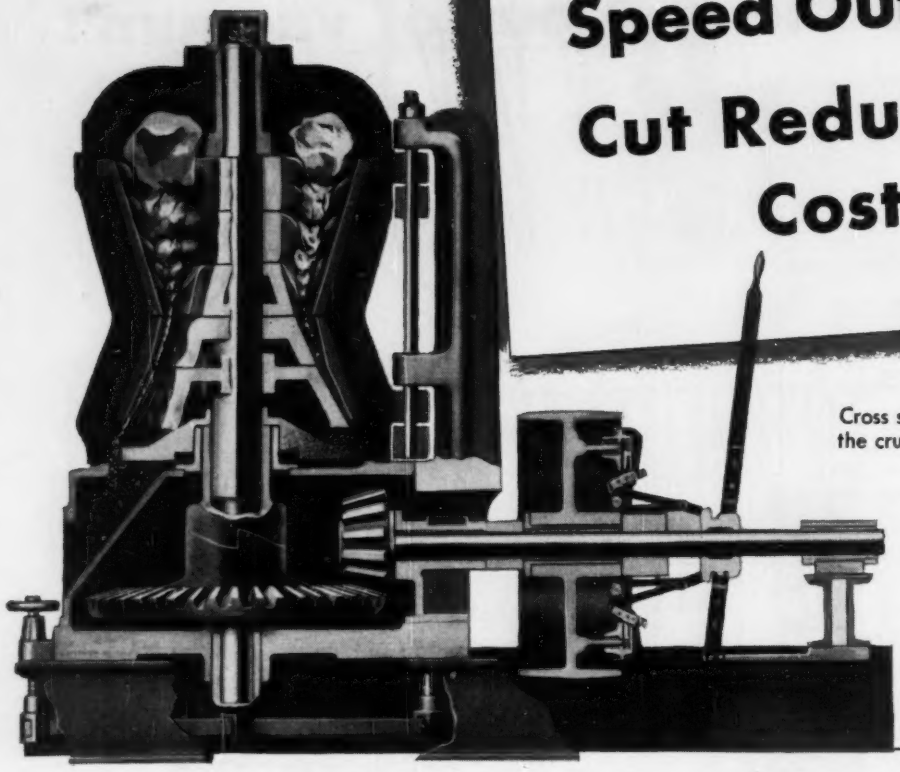
WRITE TODAY

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.

Please send engineering information on Kinney Dynamically Balanced Vacuum Pumps.

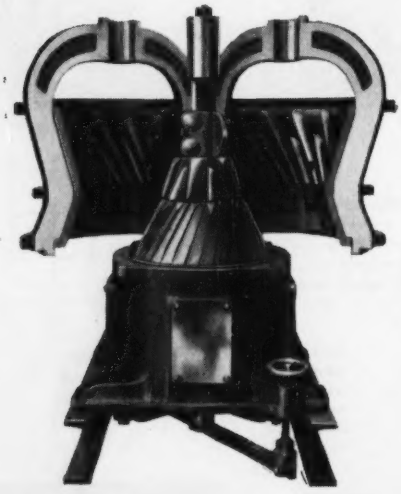
Name .....
Company .....
Address .....
City ..... State .....

Here's How to Speed Output... Cut Reduction Cost



Cross section view illustrating the crushing action.

Use STURTEVANT Rotary Fine CRUSHERS



With the Sturtevant Rotary Fine Crushers you can crush or granulate to even sizes without excess dust. By simply turning the handwheel, the crusher can be quickly regulated to crush down to approximately ¼" and finer, or opened up to produce 1" size of finished product.

"Open-door" accessibility permits fast, easy, thorough cleaning.

Sturtevant Rotary Fine Crushers crush fast... do not clog. Available in output capacities from 1 to 30 tons per hour.

Sturtevant Mill Company

100 CLAYTON STREET, BOSTON 22, MASSACHUSETTS

Designers and Manufacturers of

CRUSHERS • GRINDERS • SEPARATORS
CONVEYORS • MECHANICAL DENS and
EXCAVATORS • ELEVATORS • MIXERS

Developments in Color Measurement



GENERAL ANILINE COLORIST SAYS . . . .

"G-E Spectrophotometers Are Invaluable for Production-line Color Analysis"

"Even the most complicated color-matching problems are taken in stride by General Electric's recording spectrophotometers," says Irving W. Feyler, Colorist at General Aniline & Film Corporation, Rensselaer, New York.

Rapid production-line analysis of dyes by G-E spectrophotometers help General Aniline technicians maintain constant color control. A complete spectrophotometric curve of the most complex dyestuffs can be drawn in only 54 seconds.

MATERIAL SAVINGS are assured because costly mismatching of dyes for textile, plastic, paint, ink, paper, and other products is practically eliminated.

Versatile and accurate, the G-E spectrophotometer has a range of 380 to 700 millimicrons.* The instrument will measure both transparent and opaque samplings.

Additional savings are made by using the automatic tristimulus integrator. Provided as an accessory to the spectrophotometer, the integrator automatically calculates numerical color values at the completion of the spectrophotometric curve.

FOR MORE INFORMATION, contact your nearest G-E Apparatus Sales Office, or write for bulletin GEC-307 to General Electric, Section 585-18, Schenectady 5, N. Y.

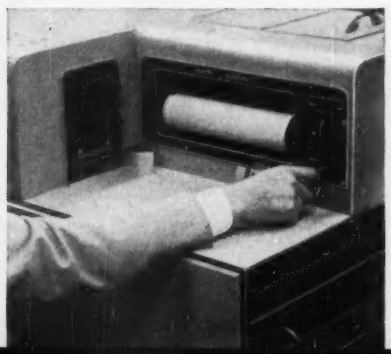
*Special ranges can also be provided.

GENERAL ELECTRIC

1. INSERTING SAMPLE and standard color specimens into G-E spectrophotometer, operator prepares to run test.



2. SELECTING RECORDING SPEED is next step. Color measurement is automatically recorded by G-E instrument.



3. ANALYSIS AND COMPARISON of test and standard curves is final step in accurate production-line color control.



here it is — the plasticizer with the flame-retardance you've been looking for—



Celluflex* CEF

another product pioneered by Celanese

Celluflex CEF builds exceptional fire-retardancy into a wide variety of plastics and surface coatings—including polyesters, vinyls, cellulosics, polyurethanes—and, in all probability, many other polymers and copolymers.

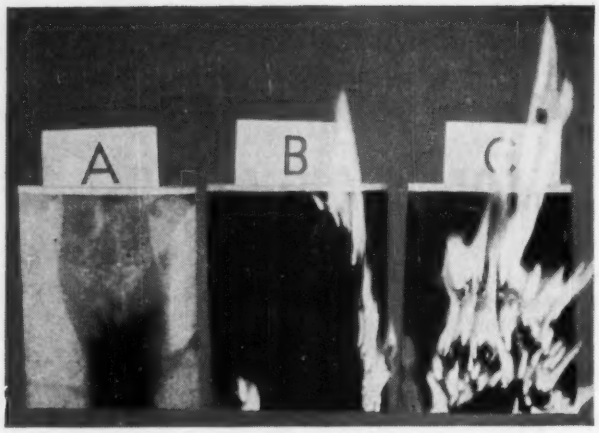
Here, for the first time in commercial quantities, is a plasticizer that provides:

flame-retardance and chemical stability

plus

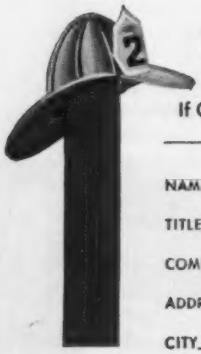
excellent low temperature properties . . .
ultraviolet light stability . . .
and a water-white color clear enough for transparent coatings.

We would like you to examine Celluflex CEF in relation to your application. Use the coupon below for test sample and technical data. Celanese Corporation of America, Chemical Division, Dept. 553-G, 180 Madison Avenue, New York 16, N. Y.



FLAME RETARDANCY TEST. 3 lacquers were formulated using same basic formula with exception of plasticizer. In Case A, it was Celluflex CEF (tris β-chloroethyl phosphate); Case B, tricresyl phosphate; Case C, dibutyl phthalate.

Lacquers were sprayed on panels, then ignited for 7 seconds. Upon removal of flame, Panel B and C continued to burn but Panel A (Celluflex CEF lacquer) extinguished itself within 2 seconds!



Celanese Corporation of America
Chemical Division, Dept. 553-G
180 Madison Avenue, New York 16, N. Y.

If Celluflex CEF can be useful in _____
_____ send me test sample and technical literature.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Celanese* CHEMICALS

*Reg. U.S. Pat. Off.



FREE FLOWING!

Process Lines of Chase® Copper Water Tube can never clog with rust!

Because process line joints of Chase Copper Water Tube and Solder-Joint Fittings have *no* internal projections, your pumping costs are kept to a minimum. Even heavy industrial fluids flow freely through Chase Copper Water Tube — its clean, smooth interior surface can *never* clog with rust!

Process lines of Chase Copper Water Tube and Solder-Joint Fittings also put an end to costly repairs and maintenance. Once installed, the system stays pressure-tight, trouble-free.

Chase Copper Water Tube comes in long lengths, is easy to install, will give you years of rust-proof service. Find out more—Contact your nearest Chase Wholesaler or Chase warehouse.

Chase®

BRASS & COPPER CO.

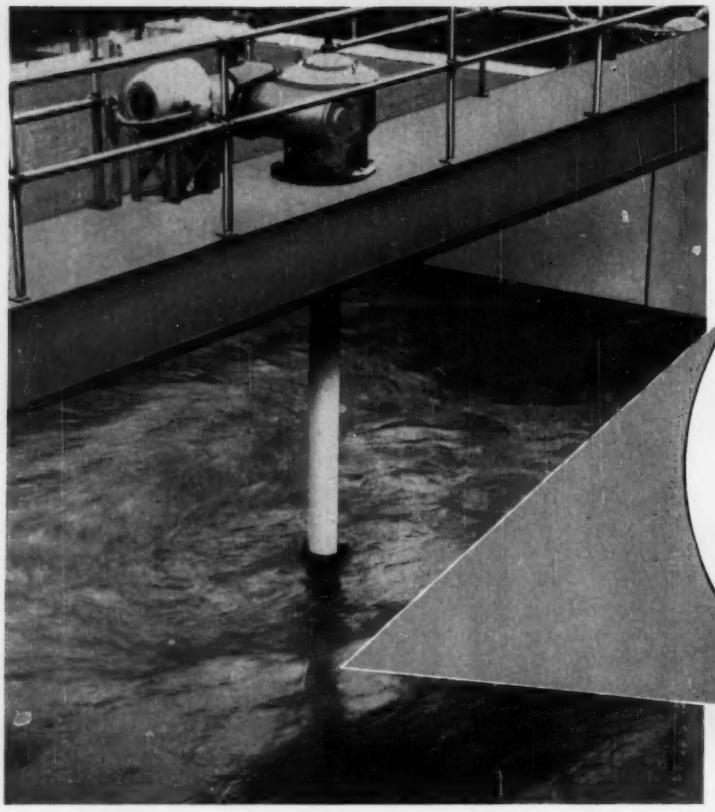
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

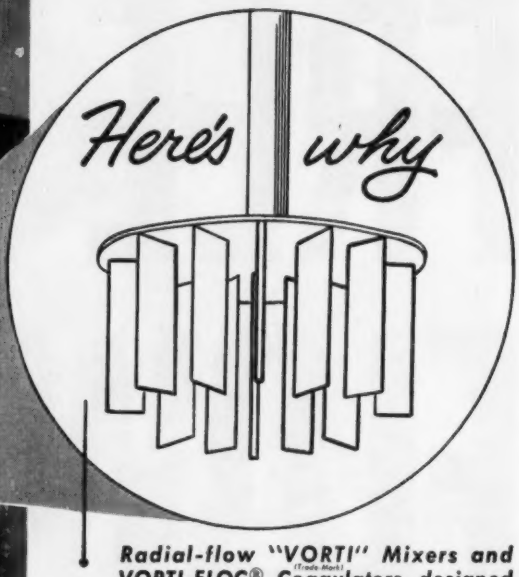
Albany†	Chicago	Detroit	Los Angeles	New York	St. Louis
Atlanta	Cincinnati	Grand Rapids†	Milwaukee	Philadelphia	San Francisco
Baltimore	Cleveland	Houston	Minneapolis	Pittsburgh	Seattle
Boston	Dallas	Indianapolis	Newark	Providence	Waterbury
Charlotte†	Denver	Kansas City, Mo.	New Orleans	Rochester†	(†sales office only)

You get better results

WITH INFILCO EQUIPMENT



for Mixing and Flocculating



Radial-flow "VORTI" (Trade Mark) Mixers and VORTI-FLOC® Coagulators, designed by INFILCO engineers, move larger volumes of liquid at lower impeller speeds than other types.

Higher efficiency at lower operating cost

"VORTI" Mixers are applicable to most problems of mixing and agitation. The impeller is usually suspended from the top of the basin without the use of underwater guide bearings, stuffing boxes or submerged chain drives.

"VORTI-FLOC" units are used for chemical treatment or for self-coagulation. They create gentle flow and turbulence by moving large quantities of liquid at relatively low velocities, thus promoting coalescence and agglomeration of suspended particles.

By proper combination of speed and size of impeller, applications of INFILCO radial flow units include:

- ***Slow stirring for equalization***
- ***Blending of liquids***
- ***Neutralization***
- ***Slow stirring for flocculation and agglomeration***
- ***Rapid mixing of chemicals in liquids***

INFILCO mixers are efficient and economical. Write today for complete details.

INFILCO

The one company offering equipment for *all* types of water and waste treatment—coagulation, precipitation, sedimentation, filtration, flotation, aeration, ion exchange and biological processes.

INFILCO INC. 905 South Campbell Avenue, Tucson, Arizona
Offices in principal cities in North America

Now



NO AIR PRESSURE NEEDED! Type EVA *contains* the explosion rather than preventing it: no "pumping up" required. Re-lamp right in hazardous areas: just switch off circuit, unscrew globe holder and replace lamp. No pressure switch to fail and create possibilities for hazard. Low initial cost and simple maintenance will mean sustained performance at top economy with these new Crouse-Hinds lighting fixtures.

200 W: with or without guard or reflector; overall length, 13 3/16".

Complete, explosion-proof lighting installations for acetylene & hydrogen areas!

CROUSE-HINDS CONDULETS®

UL Approved for Groups A and B Locations

- The first complete lighting system designed and UL-approved for Class 1, Groups A & B, as well as C & D hazardous locations.
- New lighting fixture can be re-lamped even in the presence of combustible gases: gas-tightness not required for its safe performance.
- Heavy, shock-resistant construction withstands pressures from internal explosions without rupturing.
- Flame-tight joints prevent escape of flame to flammable atmosphere.

Whether you're installing a complete explosion-proof lighting system – or merely converting a few of your Group C or D fixtures to these safer Group A's – Crouse-Hinds provides greatest safety and economy. See your Crouse-Hinds distributor, or write us.



Explosion-proof Tumbler Switch Condulets



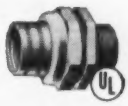
Explosion-proof Junction Condulets



Explosion-proof Sealing Condulets



Explosion-proof Flexible Couplings



Explosion-proof Condulet Unions

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y.

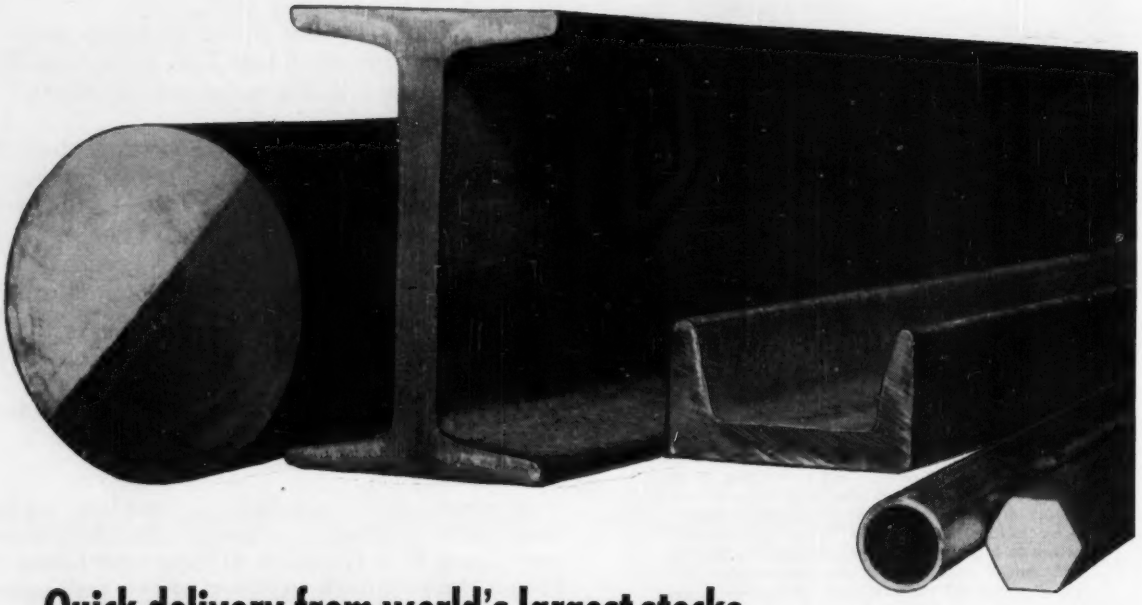
OFFICES: Birmingham · Boston · Buffalo · Chicago · Cincinnati · Cleveland · Dallas · Denver · Detroit · Houston · Indianapolis · Kansas City · Los Angeles · Memphis · Milwaukee · New Orleans · New York · Philadelphia · Pittsburgh · Portland, Ore. · St. Louis · St. Paul · San Francisco · Seattle · Tulsa · Washington · RESIDENT REPRESENTATIVES: Albany · Atlanta · Baltimore · Baton Rouge · Charlotte · Chattanooga · Corpus Christi · Reading, Pa. · Richmond, Va. · Shreveport

Crouse-Hinds Company of Canada, Ltd. · Toronto, Ont.

CONDULETS • FLOODLIGHTS • TRAFFIC SIGNALS • AIRPORT LIGHTING



call Ryerson for steel carbon, alloy, stainless



Quick delivery from world's largest stocks

Whether you need a single piece or a truckload you can depend on prompt, personal service from your nearby Ryerson plant. So, for every kind of steel—when you need it—call Ryerson.

RYERSON CERTIFIED STEELS

RYERSON STEEL

Principal products in stock: bars, structurals, plates, sheets, tubing, alloy & stainless steel, reinforcing, etc., also machinery & tools

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE, N. C. • CINCINNATI • CLEVELAND DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

Chemical Engineering
JULY 1955

A lot of the future of chemical engineering is packed into the next 32 pages

IN THE TIME AHEAD, it now seems likely that MOVING-BED TECHNIQUES will prove the most valuable of the 8 principal methods of contacting solids and gases. Their vast potential will be realized within the next few years. There are at least 19 unique advantages of these techniques.

Up to now, MOVING-BED PROCESSES have been concentrated in the petroleum and metallurgical fields. In petroleum refining the moving-bed technique is the key to new and well-known processes. It's certain, too, that it will continue to play a dominant role in petroleum processes of the future. In ferrous metallurgy, moving beds have also been highly successful. The present program for developing taconite ore—gigantic in scale—hinges on this technique. It's used for cement, limestone, gas producers, water-gas generators.

The big potential of the MOVING-BED TECHNIQUE is in brand new uses throughout the chemical process industries. Moving-bed methods can be used in a host of chemical processes. For metals themselves: titanium, manganese, cobalt, iron, rare earths, metals for atomic energy applications. For organic reactions. All these are intriguing possibilities on the horizon.

Here is the first comprehensive evaluation of the entire field of MOVING-BED TECHNOLOGY in one convenient reference—including much that has never been printed. Fundamental concepts almost as broad as chemical engineering itself. Fluid mechanics, heat transfer, mass transfer, kinetics, applied physical chemistry. Key to

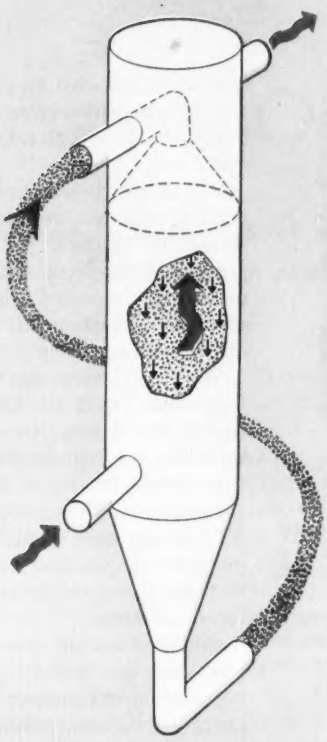
feasibility in the design of equipment usually hinges on some aspect of solids feed preparation. Other problems: solids feeding and handling, level measurements, reactor design, materials of construction, complex instrumentation.

Consider MOVING-BED PRINCIPLES and their possible application to your operations. Don't be ruled by tradition. If your operations involve bringing solids and gases together in any way, this report will give you an objective, engineering look at all the advantages inherent in moving-bed systems.

Eminently qualified for the job, your author is Dr. Raymond E. Vener of Catalytic Construction Co. Process engineer, consultant, teacher, sales engineer and author, Ray Vener knows as much about moving-bed processes as any chemical engineer in the U. S. And in preparing this report, on which he spent over five months of essentially full-time effort, he enjoyed the full cooperation of Catalytic Construction's management and large engineering organization.

Chemical engineers in all functions must take a closer look at MOVING-BED PROCESSES. No matter where you are—development, design, operating or technical management—you'll need this background of the how, where and why. So don't miss our next 32 pages.

John R. Callaham



THE MOVING BED . . . Already widely used for solids-gas contacting operations. Variations and refinements of the technique will spur extensive use in new and improved chemical and metallurgical processes.

Moving-Bed Processes

RAYMOND E. VENER, Catalytic Construction Co., Philadelphia, Pa.

SOLIDS-GAS contacting operations are among the most important and widely encountered in the chemical process industries and many techniques have been designed to cope with a myriad of special and challenging problems.

As suggested in the report on Solids-Gas Contacting (*Chem. Eng.*, May 1955, p. 163), it is much more practical from a chemical engineering point of view to consider solids-gas contacting as a broad unit operation rather than to label each specific method as a new unit operation.

The various techniques that have been developed—such as spray, moving-bed, fixed-bed and fluidized-bed methods—are refined tools for accomplishing a solids-gas contacting operation. Accordingly, in spite of our natural enthusiasm regarding the potentialities of the moving-bed principle, we suggest that you view it as a versatile instrument or technique but not necessarily as the only means for carrying out a given contacting operation.

On the basis of successful applications of moving-bed processes in various industries, there is no doubt that objective technical and economic evaluations can demonstrate their distinct superiority over alternate methods for many new uses. This is especially true for operations that require:

- Close control of temperature and product quality.
- Countercurrent flow of solids and gases.
- Negligible entrainment of solids in effluent gases.
- Simple operation.
- Minimized erosion.

While the general principle of the moving-bed technique is inherently simple and well-defined, the design of equipment must usually be custom tailored for any specific application in the chemical, metallurgical and petroleum fields. Here are some successful designs:

Petroleum Applications—Cracking of hydrocarbons by catalytic and thermal means, reforming, coking, adsorption, decolorization of lube oils and waxes, clay burning and heat transfer.

Chemical Applications — Drying, decomposition, oxidation and other chemical conversions, heterogeneous

catalytic reactions, heat transfer, ion exchange and adsorption.

Metallurgical Applications — Drying, reduction, calcination, oxidation, halogenation, sulfatization, volatilization of various components, other roasting and smelting operations, dust filtration and heat transfer.

Many of these applications have been in successful operation for years. We can learn a great deal from an appreciation of specific problems in these fields. A suitable interchange of ideas and experience can establish a basis for possible new and valuable applications.

The term moving bed as used in this report is defined as an operation in which solids move slowly downward at their normal settled bulk density either countercurrent or concurrent to the flow of gas.

The solids are present as discrete particles, granules, compacts, pellets or briquettes. They can vary in size from a fraction of an inch to several inches. The frontispiece on p. 175 is a schematic representation of a moving-bed process.

Variations are possible such as: upflow rather than downflow; internal and external heat transfer designs; feed preparation; solids flow control; conveyors; gas disengagers, seal legs and distributors.



RAYMOND E. VENER, since 1951, has been a process engineer with Catalytic Construction Co. His extensive experience covers atomic energy, chemical and metallurgical processing. B. ChE. from Villanova, he took his Ph.D. at Pennsylvania in 1948. Dr. Vener is also part-time adjunct professor of chemical engineering at Drexel Inst. of Technology where he directs graduate research and teaches graduate courses.

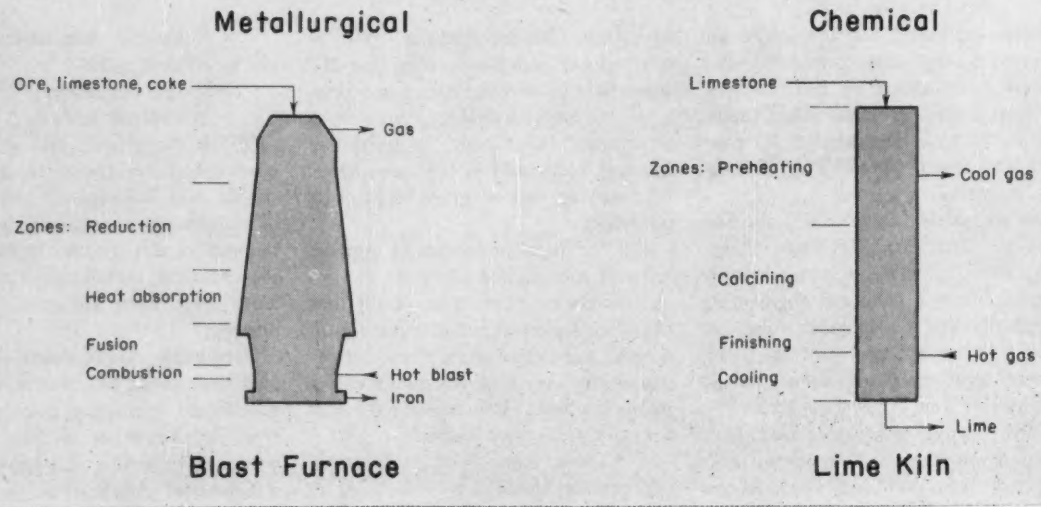
This report presents a brief summary of the history of commercial moving-bed operations. A discussion of the fundamentals of important factors in fluid mechanics, heat transfer, phase equilibria, thermodynamics and kinetics is intended to guide you in a preliminary evaluation of the suitability of this technique for your operations.

We have included a survey of engineering principles and representative equipment available for commercial processing. Suggestions are set forth for new or improved applications of solids-gas contacting processes involving the moving-bed principle.

While we believe that most of our suggestions could be developed into technically feasible processes, their suitability for commercial-scale operation should be based on economic comparisons with other methods. Such comparisons must be based on projected designs and cost estimates that use the same design philosophy for all methods.

A limited amount of scoping laboratory work and preliminary engineering is often sufficient to indicate the general technical feasibility of the process and to provide justification for a more thorough experimental program. Usually, it is more economical and expeditious to contract for such a research and development program with an organization that has demonstrated competence and know-how in this field.

Most Important Commercial Moving-Bed Operations . . .



Commercial Operation

I — COMMERCIAL OPERATION
II — FUNDAMENTAL CONCEPTS
III — ENGINEERING DESIGN
IV — NEW APPLICATIONS

Successful industry use of moving-bed units stresses their potential value in new and improved processes.

It is desirable to review briefly commercial experience in the chemical, metallurgical and petroleum fields where some variations of the moving-bed technique are used for solids-gas contacting operations. This will help present a comprehensive picture of the fundamental and engineering design principles that are involved.

The history of moving beds (shaft kilns) for cement, lime and particularly of blast furnaces for iron production, is well known. Also, many reviews of the development of catalytic processes in the petroleum industry have been published in the last several years. Consequently, we will place our emphasis in this report on illustrating significant features of various designs that may be similar and have potential value for new applications. We will not try to discuss in detail every problem of design peculiar to each application.

Metallurgical and Chemical

Shaft or vertical kilns involving moving-bed solids-gas contacting have been used for many years for the production of pig iron, copper and lead. Here we find the earliest and, in terms of investment and capacity, still the most important applications of the moving-bed method in a field other than petroleum.

Operation of blast furnaces for pig-iron—perhaps 100 ft. high by 30 ft. dia.—is so well known that it requires no detailed description here. The solid charge moves slowly down the shaft countercurrent to the gas stream. A series of complex heterogenous reactions reduce the oxides of iron, subsequently fusing the entire mass to form molten metal and to form liquid slag.

The outstanding characteristic of the modern blast furnace is its phenomenal capacity and economy. Blast furnaces have also been used for the smelting of nickel, copper, lead and tin. Their main limitation has been the problem of handling finely divided material for which reverberatory furnaces are superior.

However, the blast furnace has a much higher thermal efficiency than the reverberatory, uses a true countercurrent principle and is more suited for solids-gas contacting. The reverberatory is primarily a melting furnace. New, improved methods of feed preparation (discussed later) are the key to many problems mitigating against the use of moving-bed equipment for many uses. One such use is the handling of taconite fines.

In other than metallurgical operations the most important application of the moving-bed technique to a non-petroleum field has been the calcination of limestone. This is almost always done in a vertical or shaft kiln using the moving-bed principle. The lime shaft kiln consists of a steel stack lined with firebrick (see Fig. 1). The effluent gas may either be allowed to escape or be processed for carbon dioxide recovery.

Limestone is dumped into a hopper at the top of a shaft, preheated by hot kiln gases until it reaches 1,000 to 1,100 C. in the calcination zone, moves down into a cooling zone countercurrent to air and is withdrawn at intervals from the bottom.

There are also numerous designs of moving-bed or shaft furnaces extensively used for gas producers and water-gas generators.

Moving beds in the form of vertical shaft or stack kilns are widely used in Europe for the manufacture of portland cement. Rotary kilns are used in the U. S., but there has been considerable interest in the possibility of using vertical kilns incorporating a number of new engineering improvements.

Rotary kilns are known to be relatively inefficient in fuel consumption and involve difficulties in heat recovery, scale formation and space and cost requirements. Units are as large as 500 ft. long and 15 ft. dia.

Simplified and efficient preforming or pelletizing of feed—using drums or other methods—seems to be the key to possible use of moving-bed equipment for cement production in this country.

Petroleum

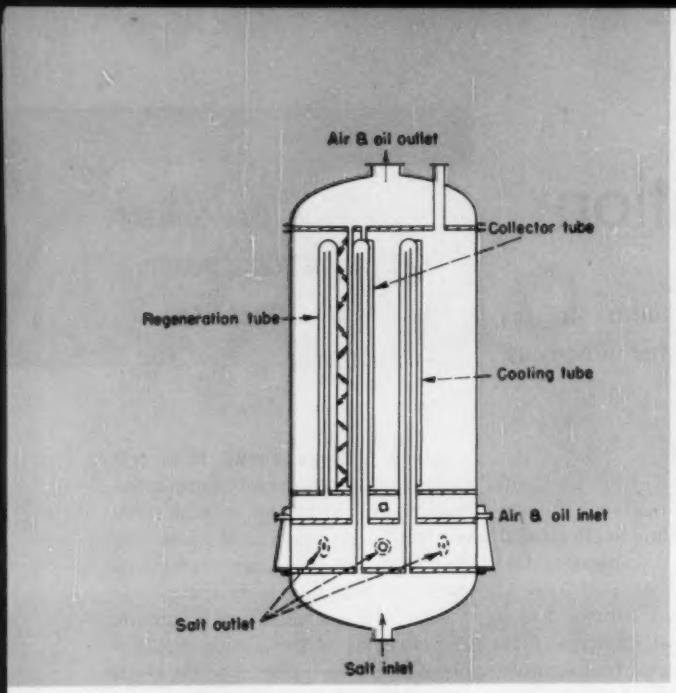
The development of fixed-, fluidized- and moving-bed processes for the catalytic cracking of petroleum oils to give high octane gasoline represents a tremendous accomplishment, a vital factor in the development of the petroleum industry.

Investigations by Eugene J. Houdry 25 years ago demonstrated the feasibility and desirability of producing catalytically cracked gasoline. The vastly increased use of petroleum crude oil and the resulting impact on the petroleum refining business has been a powerful stimulus for extensive research and development.

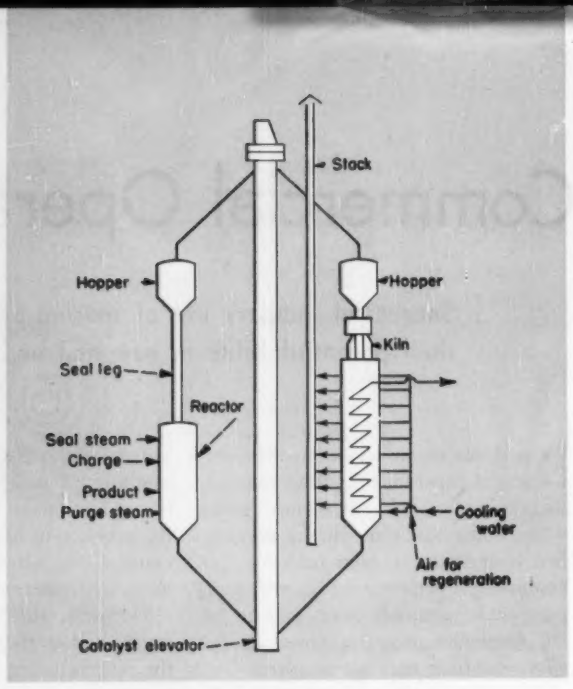
In conjunction with fundamental studies of catalyst and process variables, completely novel engineering approaches were required for the design of commercial-scale production equipment.

Houdry Fixed-Bed

Development of the fixed-bed catalytic cracking process involved the design of a reaction vessel where heat would be supplied during the cracking step and be removed during the regeneration of the catalyst. Although fundamental research had shown that extended surface materials promoted cracking of oil vapors, the commercial realization of the process was not accomplished until the catalyst had



HOUDRY FIXED-BED catalyst case—Fig. 3.



THERMOFOR CATALYTIC CRACKING (TCC)—Fig. 4.

been put to work as a heat carrier and a carbon carrier.

During the catalytic cracking of oil vapors a carbonaceous deposit is left on the surface of the catalyst. It builds up rapidly and interferes with the rate of cracking. The catalyst activity can be restored by burning this carbon deposit with air.

Houdry found that the oil vapors could be exposed to the catalyst for a relatively brief period of time before regeneration is required. Aside from the carbon deposit decreasing the apparent catalyst activity, excessive build-up of carbon results in high temperatures during the regeneration step. This deteriorates the catalyst. The catalyst has to be purged with steam to remove adsorbed oil before it can be regenerated. Following regeneration, the catalyst is purged by evacuating the air.

After establishing the cyclic nature of the process, means for supplying heat during the cracking step and removing heat during regeneration had to be found. In general, the design of a Houdry fixed-bed catalyst case is governed by:

- Rate of heat removal (about 10,000 Btu./hr.-cu. ft. of catalyst space).
- Temperature control during cracking.
- Limitation of maximum regeneration temperature.
- Catalyst bed depth and uniform distribution of both vapor and of air.
- Mechanical considerations of assembly, thermal expansion, catalyst loading, unloading, etc.

Temperature control in the Houdry fixed-bed reactor is not simply a matter of removing heat to avoid excessive temperature or addition of heat during cracking. Instead, it involves maintenance of temperatures within a narrow specified range. Inadequate heat removal during regeneration could cause hot spots within the catalyst mass and destroy its activity. Excessive cooling would condense liquid oil on the catalyst leading to trouble in purging and regeneration.

Uniform distribution of vapors in the catalyst case is accomplished with multiple vapor inlet and outlet tubes and by use of catalyst in the form of pellets or beads approximately $\frac{1}{8}$-in. dia.

In order to effect a continuous flow of vapors, three or more catalyst cases are required. An intricate system of valve control is needed to perform this operation safely since oil vapors and air are passed alternately through the bed. A cycle timer and motor-operated valves control the sequence of operations automatically.

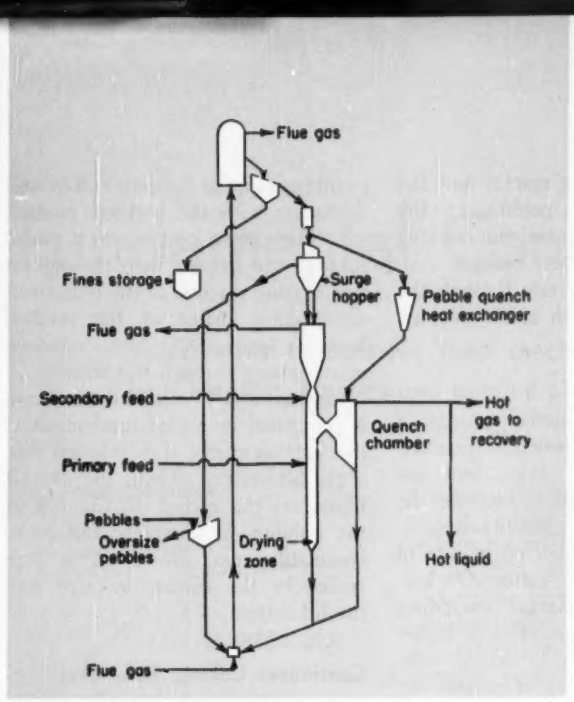
In spite of the development of new units that circulate catalysts at high rates, fixed-bed operations are still very widely used in the petroleum industry for catalytic cracking and reforming of hydrocarbons. However, the high investment and complexity of operation involved in fixed-bed catalytic cracking served as a major impetus for the development of the moving-bed technique.

Thermofor Catalytic Cracking

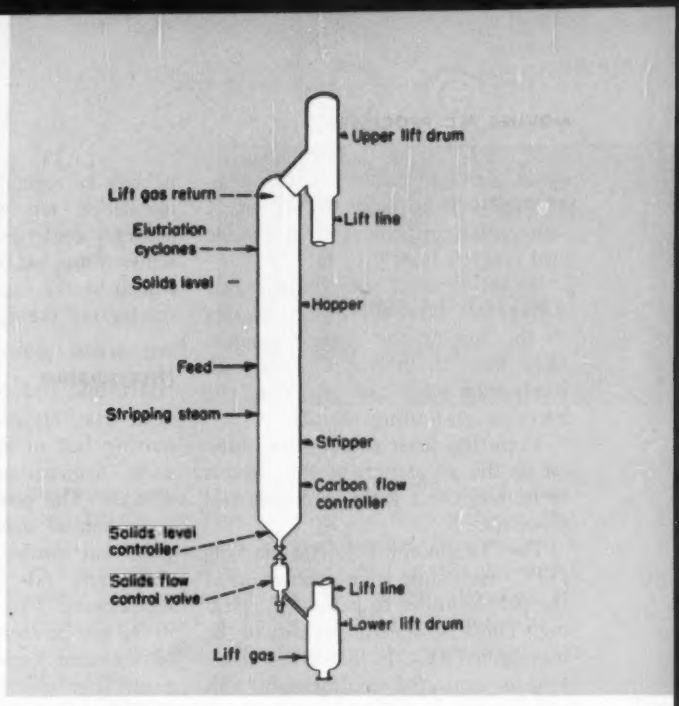
During the commercialization of the Houdry fixed-bed process, the Thermofor kiln was developed for continuous regeneration of percolation clays. The kiln was the forerunner of later TCC (Thermofor Catalytic Cracking) kilns now used for regenerating cracking catalyst. It was introduced in 1939 to displace multiple hearth kilns or rotary burners which, because of their poor heat control and heat transfer characteristics, permitted rapid degradation of clays during regeneration.

Two kinds of kilns were developed: salt tubes interlaced with stacked angle irons; salt tubes equipped with spiral fins that provide better heat transfer, easier assembly, less maintenance and more design standardization.

Clay feeds from a hopper to and through the Thermofor kiln by gravity flow. The clay flows freely over metal surfaces and flow rate is controlled by a valve or orifice at the bottom of the kiln. Air for burning the deposits from the clay enters from a tubular manifold at the bottom and



PEBBLE HEATER for catalytic cracking (TPC)—Fig. 5.



HYPERSORPTION with activated carbon—Fig. 6.

passes upward countercurrent to the clay stream.

Flue gases leave the top and pass through a cyclone separator to remove entrained particles. The clay recovered from the separator returns to the feed hopper. Temperature of the clay or other solid being burnt is carefully controlled by providing adequate heat transfer surface to absorb the heat of combustion. Molten inorganic salt circulates through the heat transfer elements for either cooling or heating the material.

In view of the economies of initial plant investment, maintenance and operating costs in adapting the Thermofor kiln to catalytic cracking processes, the moving-bed TCC process was the logical successor to the Houdry fixed-bed process.

Two principle vessels, a reactor and a regeneration kiln, comprise a TCC unit and continuous operation is accomplished by circulating the catalyst through the reactor and then through the kiln (see Fig. 4). Mechanical elevators carry spent catalyst from the bottom of the reactor to the top of the kiln and regenerated catalyst from the bottom of the kiln to the top of the reactor.

Catalyst flows downward through these two vessels as a continuous body of solids at substantially their normal settled bulk density. Gas flow may be concurrent downward or countercurrent to the solids provided the rate of gas flow upward is not high enough to cause the bed to boil. Catalyst enters the reactor through a vertical pipe which acts as a seal preventing the escape of oil vapors.

The seal leg is kept full of catalyst and is constantly purged upward from the reactor by inert gases. Oil vapors disengage from the catalyst into purge steam supplied through catalyst distributor tubes or channels in the bottom of the unit. An orifice or a rotary valve at the bottom of the unit controls the rate of solid flow.

Combustion with air in a multiple zone arrangement regenerates the catalyst. Here, catalyst temperature is controlled by circulation of water through cooling coils.

Cracking catalysts of suitable physical properties to withstand attrition had to be and were developed.

Houdriflow Catalytic Cracking

Houdriflow is a moving-bed catalytic cracking process that uses a gas lift—instead of mechanical elevators—to transport catalyst. Since the reactor is superimposed over the kiln, the catalyst is lifted only once to complete a flow cycle through the unit.

The catalyst gas lift removes the restrictions that had been placed on the amount of circulating catalyst by practical limitations of mechanical elevators. This permits higher catalyst-to-oil ratios. Greater flexibility is achieved in the choice of operating conditions and the type of charging stock (from completely unvaporized feed to any ratio of liquid to vapor).

The higher catalyst circulation rates also deposit less coke on the catalyst. This in turn leads to fewer burning zones in the regeneration kiln. Instead of seven to ten burning zones required in a TCC kiln, for example, only one or two zones are used in the Houdriflow kiln.

The original Houdriflow units used a separate reactor and kiln with a seal leg between the vessels. Newer units use a single shell for reactor and kiln. This decreases the over-all height, eliminates the problem of collecting catalyst in the reactor and redistributing it in the kiln.

In the reactor the flow of oil is concurrent with the catalyst. This permits the introduction of either liquid or vapor feeds. The kiln is operated with countercurrent flow of catalyst and air.

A novel feature of the Houdriflow gas lift system is that the catalyst circulation rate is controlled solely by lift operating conditions. No valves or other devices are needed to regulate catalyst rate.

Thermofor Pyrolytic Cracking

An interesting innovation in moving-bed processes is the development of the pebble heater for superheating

steam above normally available temperatures. It involves circulation of various kinds of pebbles whose specific heat range is from 0.25 to 0.30.

Bucket elevators raise the relatively cold pellets from the lower chamber to the top of the upper chamber. Here they are heated directly with combustion gases and passed to the lower or gas-heating chamber.

There has been considerable interest in the adaptation of this process to heating other gases in commercial processes.

The Thermofor pyrolytic cracking (TPC) technique is an application of the pebble heater to petroleum cracking. The TPC system is similar to the moving-bed TCC in that hydrocarbon feed is contacted continuously with a moving bed of solids. The process differs in that noncatalytic solids circulate in the unit and the temperatures are higher.

A reactor and a heater are the main elements of the TPC system. A bucket elevator lifts the pebbles to the top of the unit where they are discharged into the heater. Direct combustion of fuel gas in the pebble feed preheats them to the desired temperature level. Any coke deposited on the pebbles burns off in this step. Then, the hot pebbles flow by gravity from the heater into the reactor. Here, the heat stored in the pebbles preheats and cracks the hydrocarbon feed.

Efficient heat transfer from the pebbles to the hydrocarbon feed gives rapid heating to high temperatures. The cold pebbles from the reactor flow through a throttling valve into the elevator which returns them to the top of the unit for reuse.

The pebbles used in this process are ceramic materials of spherical shape, 0.2- to 0.4-in. dia.

The flow of hydrocarbons is countercurrent to the flow of pebbles in the reactor. The feed is preheated or introduced cold directly into the lower section of the reactor where residual heat is available in the pebbles for preheating or vaporizing it.

This type of reactor gives heat transfer rates in the order of 15,000 Btu./hr.-°F.-cu. ft. of pebbles.

Charging stock is preheated to high temperatures very rapidly and undesirable cracking at low temperatures is minimized. The temperature of the pebbles entering the reactor and the circulation rate of pebbles to the hydrocarbon feed control the cracking temperature. Contact time is controlled by the vapor rate through the reactor and the depth of the pebbles.

Hypersorption

In the Hypersorption process a moving bed of activated carbon adsorbs hydrocarbons from lean gas streams. The process is used for the separation of light gases when processes that involve high circulation of absorption oil or extremely low-temperature fractionation operations would not be economical. The ability of activated carbon to adsorb relatively large quantities of volatile hydrocarbons at low pressure is the principle underlying the development of this process.

We have shown a sketch of a Hypersorption unit in Fig. 6. Activated carbon flows by gravity through an exchanger section of the column where the carbon is cooled before entering the adsorption section. Feed gas flows countercurrent to the moving bed of carbon.

The carbon adsorbs heavier components in the feed and the lighter compounds disengage from the carbon below the cooler and leave the system through a cyclone separator.

The activated carbon continues its downward flow below the feed point and enters the rectifying section of the column. Here it contacts a reflux of heavier compounds liberated from the carbon in the stripping section at the bottom of the column.

The reflux acts similar to reflux in a fractionating tower and serves to liberate light components which may be retained on the carbon. As the carbon moves downward it passes through a disengaging section where it meets an upward flow of steam. The steam releases the adsorbed heavier components from the carbon. These heavy components are either withdrawn as bottoms product gas or returned to the rectifying section as reflux.

The carbon then flows to the stripper and through tubes which are heated by a circulating heat-transfer medium. Steam is also introduced below the stripping section, passes countercurrent to the carbon flow and discharges with the bottoms product gas. The carbon heats up as it passes through the stripper with the highest temperature reached at the bottom of the section. Most of the residual heavier components are removed when passing through this section.

Carbon flow through the column is controlled by a feed mechanism at the bottom where it is released into a gas lift system. Then, the gas lift transports the carbon to the top of the column to complete the cycle. Circulation rate of carbon is controlled by the amount released into the lift system.

Continuous Coking, Reforming

Continuous contact coking is used to convert extremely heavy hydrocarbons to coke and light oils by contacting with a continuous circulating stream of hot coke. The preheated charge enters the coke bed at about 800F. The lighter portions are vaporized and the heavier oils are retained on the coke particles.

After a 15- to 40-min. residence time, coking and drying of the heavier unvaporized oils are completed. The coke moves down through the reactor as a compact bed and discharges from the bottom of the reactor to the lift unit. Here it is elevated to a lift disengager and then flows by gravity into the reheater. Radiation and convection raise the coke to the proper temperature for the coking reaction. It is discharged to the reactor to complete the cycle.

The lump coke consists of many layers (0.001-in. thick) and has a very dense structure since it is reheated after each passage through the reactor. Characteristics of continuous contact coke are low volatile content and high mechanical strength.

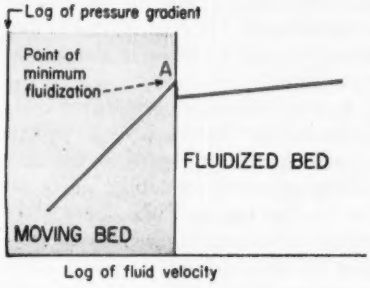
There is a net production of coke in the process which is drawn off as dry lumps about ¾-in. dia.

The moving-bed technique is also used for the production of high octane gasoline in the Thermofor Catalytic Reforming and the Hyperforming processes. Bucket elevators are used for solids recirculation in the former while a dense phase gas lift is used to circulate the catalyst in Hyperforming.

Fundamental Concepts

You'll want to consider fluid mechanics, mass and heat transfer, kinetics and applied physical chemistry.

I — COMMERCIAL OPERATION
II — FUNDAMENTAL CONCEPTS
III — ENGINEERING DESIGN
IV — NEW APPLICATIONS



To appreciate fully the potential of new moving-bed applications you will find it valuable to consider some fundamentals underlying the operations that are involved. Important basic considerations include: fluid mechanics, mass and heat transfer, kinetics and principles of applied physical chemistry.

Later, under the heading of "Engineering Design," we will discuss factors of a more applied nature. These include feed preparation methods, conveying, level measurement, flow control and reactor design.

This section on fundamentals is intended to illustrate the essential similarity of the elements underlying operations that appear to be greatly divergent.

Fluid Mechanics

Fluid mechanics is a very important consideration in the design of moving-bed units, particularly in its effect on heat transfer, temperatures, reaction rates and mass transfer. Not only does it include the flow of reactants through packed beds but also gas distribution, flow control and use of gases for various sealing devices. The flow properties of solids are vital related variables.

Flow patterns for gases through moving-bed units are very complex. However, substantial progress has been made in postulating mechanisms that permit satisfactory correlations of pertinent variables.

Chemical engineers occasionally confuse the terms "moving bed" and "fluidized solids." Therefore, we will delineate carefully the basic mechanisms of a moving-bed process.

When a gas passes up through a stationary or moving bed of granular or pelletized solids, a pressure differential is needed to overcome friction. The higher the gas flow rate, the greater the pressure gradient required (see cut above, Fig. 7).

Finally, as the gas velocity is continuously increased, the pressure drop becomes equal to the sum of the weight of the bed per unit cross sectional area plus friction of the bed along the walls. This may be called the point of incipient or minimum fluidization.

When the point of minimum fluidization is reached (point A on Fig. 7), two things may occur. First, with free-flowing materials the bed expands to a more open configuration permitting gas to flow without the pressure differential exceeding the unit bed weight. Then as the gas velocity increases further, pores and openings enlarge and the particles become more widely separated.

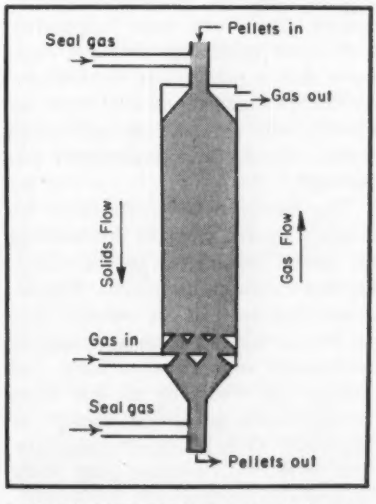
The pore openings finally become so large that particles circulate or vibrate in a random fashion. This has been referred to as aggregative fluidization; because of the concept of the solids moving as aggregates that continually disintegrate and reform.

The solid bed bubbles in the same way that a gas bubbles through a liquid. Bubbles of fluid rise through the bed, break at the surface and eject particles of solids upwards. With further increase of fluid velocity, the bubbling becomes very violent and streamers or ribbons of solids are ejected a considerable distance above the bed.

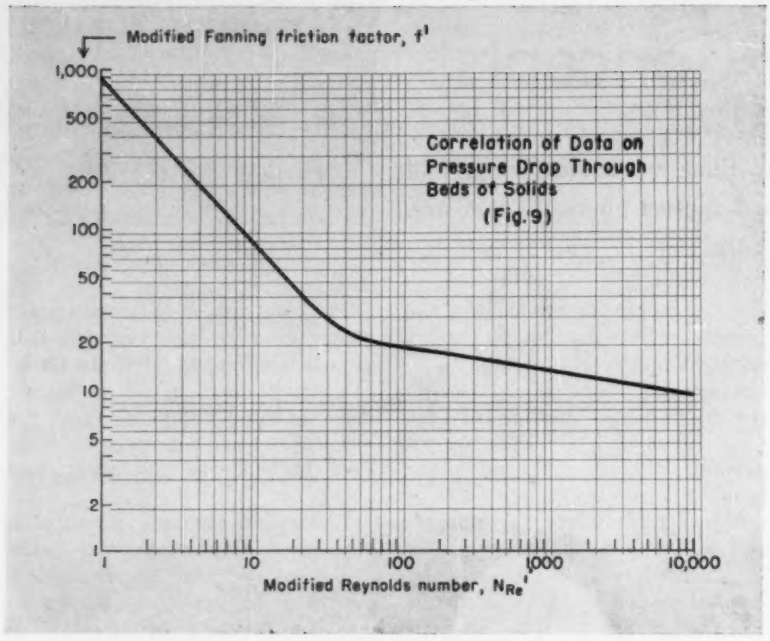
The condition of "fluidized solids" occurs when we have materials that are not free flowing. Here the entire bed may be lifted by the gas stream and rises like a piston. Although the bed may expand, the operation is far from uniform and channeling may occur.

Moving-bed processes referred to in this report involve operating below the point of minimum fluidization. Normally the operation sketched in Fig. 8 involves a bed of granular solids or pellets moving at essentially its normal settled bulk density, either downward (as in most commercial operations) or upward. Depending on the particular application, the gas flow may be concurrent, countercurrent or a combination of these.

In some applications, it may even be desirable to pass gas normal to the flow of solids. Gas may be admitted or removed either at the top and bottom of the reactor or at numerous locations along the reactor, depending on the need for temperature and reaction control.



NORMAL OPERATION of moving-bed equipment—Fig. 8.



Because of widespread interest in packed beds, heterogeneous catalysis, metallurgical operations, heat transfer, absorption, adsorption and distillation, a tremendous amount of experimental data have been accumulated on flow of gases through beds of solids. However, in spite of all the published information, the complex flow mechanics that are involved in these chemical engineering operations are still not adequately understood.

Empirical treatments are the only reliable bases for equipment design. Indeed, there have been suggestions from some prominent chemical engineers that a moratorium be declared on further fundamental studies of gas flow through packed beds until more realistic theories and concepts are formulated.

The use of experimental data for design purposes generally involves one of several variations of the basic Chilton-Colburn correlation. This assumes that most of the pressure drop in the turbulent region is caused by contraction and expansion losses and changes in direction as gas flows through irregular orifices formed by the solids. Only a relatively small percent of the total pressure drop is due to true skin friction.

Contraction, expansion and skin friction losses are all roughly proportional to the square of the gas rate. Accordingly, empirical correlation analogous to the familiar Fanning equation for fluid flow in open conduits is reasonable. This assumes the form of a plot of modified Reynolds numbers vs. a modified Fanning friction factor (see Fig. 9).

One form of the variables to be plotted might be this:

Modified Reynolds number = $N_{Re}' =$

$$[D_p G_o/\mu]\,[1/(1-\epsilon)]$$

Modified Fanning Friction Factor =

$$f' = \left(\frac{\Delta p_f g_c D_p \rho_m}{L G_o^2}\right)\left(\frac{\epsilon^3}{1-\epsilon}\right)$$

where g_c is a unit conversion factor; Δp_f = pressure drop due to friction; L = depth of packing; G_o = superficial mass velocity based on cross section of the empty tube; ρ_m = mean density of the fluid; ϵ = fraction voids; D_p = surface-mean particle dia. = $6/a_p$; a_p = ratio of surface to volume of a particle.

Parameters are used to correlate and reduce the scatter of data on plots. They are:

- Porosity of bed.
- Particle diameter.
- Shape and sphericity of particles.
- Packing or orientation of particles.
- Roughness factors.

Many modifications and refinements of these correlations have been proposed. The relative importance of the variables is contingent on the particular application.

For N_{Re}' less than 10, the flow is considered to be essentially laminar. The range of N_{Re}' greater than 10 and less than 100 is commonly referred to as transitional. For N_{Re}' above 100 the flow is considered to be in the turbulent region.

Just as in flow through empty conduits, surface characteristics of pellets or particles are important in the turbulent zone but have little effect in the laminar region. There is an interesting difference between open conduit and packed or moving beds within the transitional region. Unlike open pipes where an abrupt change in flow occurs at N_{Re}' of about 2,100, the transition in packed beds is a very gradual one.

We should emphasize that in the case of moving beds, we can not consider the gas flow as though the bed of solids is fixed in place. The uniformity of solids flow and the characteristics of the bed over the cross section have an important bearing on the pattern of gas flow.

Therefore, it is important to reduce or minimize channeling that results from nonhomogeneous bed densities. If irregular or nonuniform solids flow or bridging occurs, disproportionate amounts of fluid pass through paths created by channeling. This, in effect, means that the fluid bypasses large portions of the bed.

An interesting feature of the flow of pellets through orifices is that the flow of solids is a function of the orifice diameter but that the head of solids over the orifice has practically no effect on the flow.

Heat Transfer

Many experimental and theoretical studies have been conducted on heat transfer and temperature profiles in both fixed and also in moving beds of solids.

Mechanisms for most moving-bed applications are extremely complex and not well understood. This is espe-

cially true when heat transfers from beds of solids through exchanger coils with gases in turbulent flow through beds of granules or pellets.

Comprehensive mathematical treatments must take into account the various heat transfer factors that are listed below:

- Transfer of heat through solids particles. This includes flow of heat between particles through the gas stream and gas films around the solids and flow of heat between particles through points of contact of solids with adjoining stagnant gas.
- Radiation from particle to particle.
- Transfer of heat through the gas phase by turbulent eddy conduction or by molecular conduction.
- Transfer of heat to secondary fluid by flow through film of gas, through metal tubes and flow to fluid within internal exchanger tubes.

The relative importance of these mechanisms varies considerably for a given system. It depends on conditions of operation. Any attempt to generalize for the large diversity of processes that use the moving-bed principle would be impossible.

The long-range objective of heat transfer studies on fixed- and moving-bed reactors is to provide a procedure for evaluating contributions of each mechanism from accurate calculations and correlations. This is intended to provide over-all values for engineering design. Experimental studies utilize both steady-state and unsteady-state measurements.

As yet it is not possible to obtain coefficients of heat transfer by mathematical calculation of the effect of individual resistances involved in moving-bed processes.

The over-all coefficient of heat transfer is not the sum of the values calculated for the individual resistances to heat transfer.

Predicting conversion as a function of length in a moving-bed reactor is complicated by variations of temperature, composition and velocity in the radial direction. For precise calculation of temperature and composition profiles across the reactor diameter, we would need reliable information on both radial heat and also on mass transfer rates.

There has been considerable progress in explaining these mechanisms. One of the more promising theoretical tools is the use of analogies of momentum, heat and mass transfer. However, industrial moving-bed designs are based on experimental data and practical experience. At present these are still the only reliable methods.

There are too many large discrepancies—even for simple reactions—between actual performance and values predicted from theoretical calculations of individual resistances.

Over-all coefficients of heat transfer to internal exchanger tubes in moving-bed units are perhaps a fifth of values for comparable fluidized-solids installations. However, the coefficients in moving-bed reactors are adequate for most applications, particularly since we have numerous auxiliary techniques for heat transfer and temperature control.

The over-all heat transfer coefficients from moving beds of solids to metal exchanger tubes located within a reactor will usually range from 5 to 20 Btu./hr.-°F.-sq. ft. of exchanger surface. The value depends on gas flow and distribution, design of coils and the thermal conductivity and heat capacity of the solids.

As discussed earlier, the disadvantage of a smaller heat transfer coefficient is more than offset by many other inherent advantages of moving-bed techniques.

For new applications, assumptions made about the method to be used for controlling operations and the removal and addition of heat may well be the dominant factors in determining the apparent feasibility of the process.

For instance, it may appear attractive to design a process for adiabatic operation with heats of reaction balanced by sensible heat changes of solids and/or gases. This might eliminate the need for internal heat exchangers. However, this concept is usually an oversimplification because of the difficulty of controlling the reaction.

The required recirculation of solids to achieve such heat balances would usually be tremendous. This is particularly true for strongly exothermic and endothermic reactions.

Internal heat exchangers can usually be designed for simple, reliable operation. If used for only part of the heat duty they can greatly reduce the solid recirculation load. Many other techniques are available such as the addition of inert solids to serve as diluents.

We can also add solids that are able to absorb large quantities of heat by decomposition, metal carbonates for example. Other solids can react with gases to raise temperatures to desired levels by providing additional heat from exothermic reactions.

We'll illustrate the flexibility of the moving-bed technique with the simplified test unit in Fig. 10. Heat exchangers and instrumentation—which are important adjuncts—are not shown.

Reaction zones and temperature control are arranged as required by the succession of operations. Provisions may be incorporated for successive zones involving different gases, temperatures and gas flows. Many design combinations are possible.

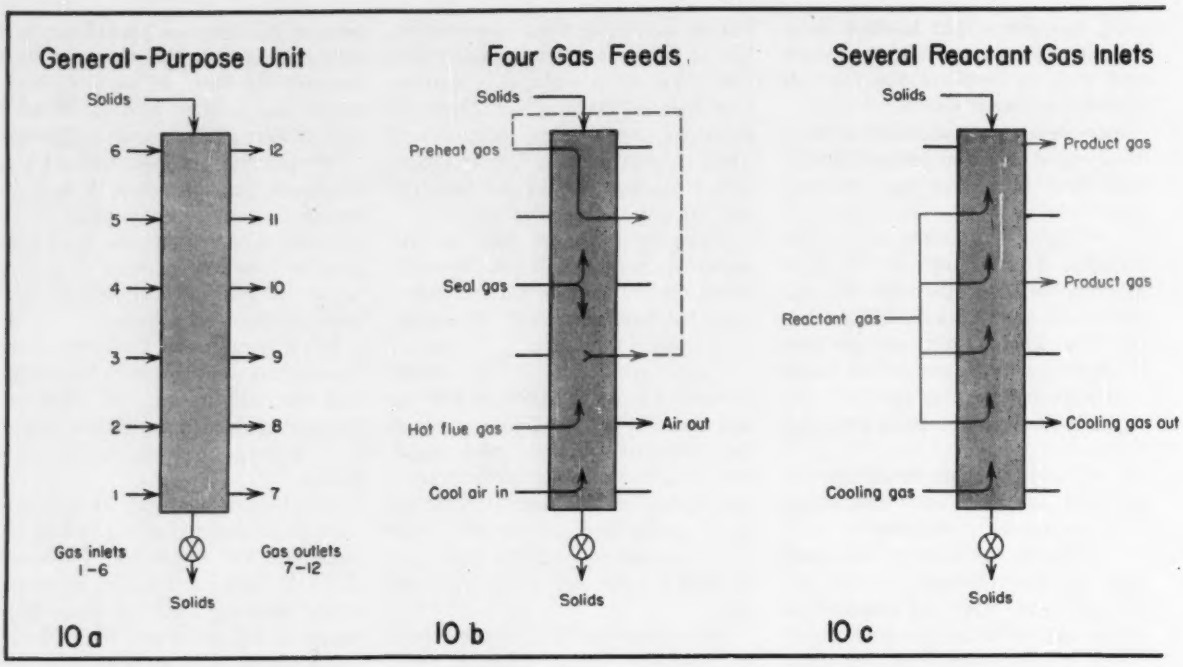
Among the factors that influence heat transfer characteristics of moving bed operations are:

- *Properties of materials*—thermal conductivity; heat capacity; density of gases and solids; viscosity of gases; size, shape, porosity and other characteristics of solids.
- *Operating Conditions*—gas velocity; feed or recycle rate of solids; temperature and temperature gradients; heats of reactions; capacity; size of temperature driving forces; precision of the temperature control that is required.
- *Equipment Design*—location, size and shape of heat transfer surfaces in conjunction with the over-all design of the reactor.

In our section on engineering design we will discuss many other factors. Moving-bed techniques are readily adaptable for transferring heat either alone (as in pebble heaters) or in conjunction with various catalytic or noncatalytic solids-gas contacting operations.

Mass Transfer

Where chemical reactions are involved, we can use equilibria data to predict how far the process will proceed with unlimited retention time. Reaction kinetics and diffusional transfer of material are the rate-determining



factors which control the extent to which the equilibria can be approached in a finite time.

These are the key factors that establish equipment capacity and size. As a rule, we can not predict whether a new application will be limited by chemical or diffusional resistances. Each application must be studied experimentally.

The rate of diffusion or mass transfer, N, is considered proportional to a concentration difference, ΔC, causing the diffusion. It is also reasonable to assume that this rate is proportional to the interfacial area, A. This proportionality relationship becomes an equality if we insert a factor, K.

$$N = KA\,\Delta C$$

Both sides of the equation must have identical units. Therefore, the units of K (the so-called mass transfer coefficient) depend entirely on the units you select for the other factors in the equation.

The relative importance of eddy and molecular diffusion in the over-all process is unknown. We lump these and other factors (undoubtedly involved in an accurate representation) into an effective coefficient. Although of limited theoretical value, this has proved to have great value in engineering design.

Far more studies have been conducted on the mechanism of fluid flow through beds of solids than for mass and heat transfer. For turbulent motion of fluid through a fixed or moving bed, momentum transfer by eddy motion is superimposed on molecular transfer. Momentum transfer rate is a function of the degree of turbulence. For highly turbulent conditions, the eddy effect predominates.

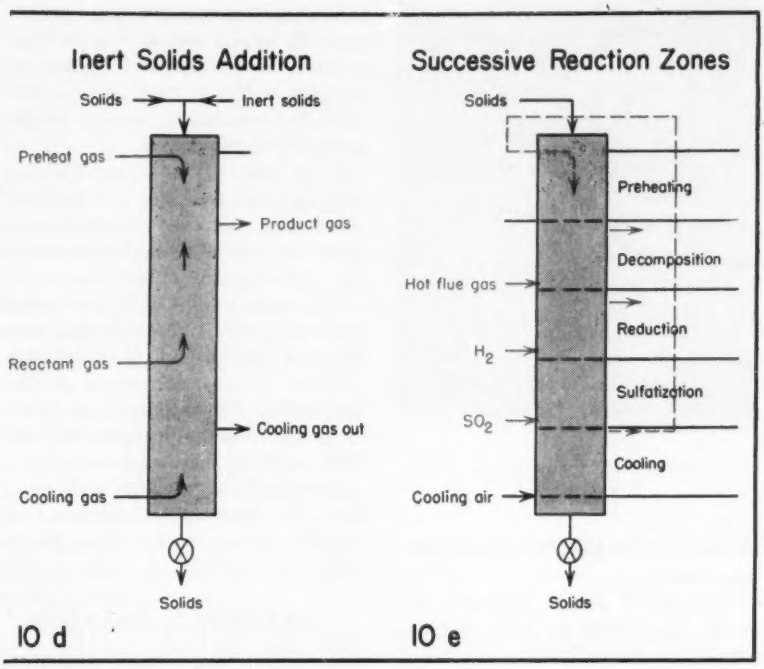
Similarly, the molecular and eddy effects work to reduce any temperature or concentration gradients. As in the case of momentum transfer, heat and mass are transferred by both eddy and molecular diffusion. However, major resistance to transfer exists in regions where molecular diffusion controls.

In simplest terms, the rates of transfer of momentum, heat and mass are proportional to driving forces for these quantities expressed respectively as pressure, temperature and concentration differences. For the turbulent flow conditions that we usually find in moving-bed operations, theoretical development is still limited by a sparsity of information about eddy diffusion and the effect of temperature gradients on velocities. Further work is required to establish a sound theoretical basis leading to a real understanding of the mechanisms that are involved.

In the meantime, available theory and data are of tremendous value in correlating and extrapolating experimental data. We want to emphasize again that the engineering design of mass transfer equipment is still based primarily on empirical techniques, practical know-how and scale-up from experimental data.

In the vast majority of solids-gas contacting operations, both momentum and heat transfer accompany mass transfer. The rates of the three are interdependent. One of the major goals of chemical engineering research is to provide a common denominator in terms of a sound underlying mechanism for the growing number of apparently diverse unit operations. A start has been made in the efforts to group many of these operations into the general category of "diffusional operations."

In practically all cases considered in this report the mass transfer mechanisms are extremely complex and we can not define the motion of the fluids in mathematical terms. Consequently, mathematical and graphical correla-



10 d 10 e

tions of data on mass transfer with fluids undergoing turbulent flow are essentially empirical. This is similar to the treatment accorded friction losses and heat transfer.

Transfer Analogies

Analogies of momentum, mass and heat transfer are of considerable academic interest. As yet, they are of very limited value for the purpose of design.

Results to date indicate that both mass transfer and heat transfer are functions of velocity gradients in turbulent flow. This tends to confirm views that the three basic types of transfer are closely related. In any event, this has been the general basis for proposed analogies.

Available diffusional theories of mass transfer are valuable in providing a picture showing how the transfer occurs. They facilitate correlation of experimental data and permit qualitative predictions of the effects when we change variables over limited ranges. But it is not yet possible to make absolute calculations for design and operating purposes.

If this is true for relatively simple solids-gas reactions such as calcinations, it is certainly true for very complex chemical reactions.

Considerable doubt exists among chemical engineers about the efficacy of using film concepts in future studies of basic mechanisms. There are many discrepancies between experimental and theoretical results. The assumptions of ficticious films on which to predicate apparent resistances must eventually be supplanted by a more valid and realistic concept of turbulent flow conditions.

Even if we knew gaseous diffusivities with great accuracy, we could not calculate the individual film coefficient without knowing effective film thicknesses. The interfacial area is another quantity on which little exact information is available for use in engineering design.

Two concepts are now being considered: assume a physical film of negligible capacity, but with finite resistance; assume unsteady-state molecular diffusion of solute into the entire mass of fluid.

Neither appears to be completely satisfactory. It is hardly reasonable to imagine the existence of truly stagnant films in moving-bed reactors through which gas passes in turbulent flow.

Applied Physical Chemistry

We cannot overemphasize the importance of a thorough appreciation of physical chemical principles in engineering design as well as research and development of a process. No attempt has been made here to cover thoroughly even one phase of this very large subject.

Our discussion is intended to illustrate the practical value of such concepts as indispensable tools for correlating and interpreting data for design and operation of commercial equipment.

We will divide our discussion under two headings: phase rule; and chemical equilibria.

Phase Rule

One of the most valuable guides provided by thermodynamics and physical chemistry is the familiar Gibbs' phase rule:

$$P + F = C + 2$$

In this form, the rule applies to the equilibrium between any number of phases. It is affected only by temperature and pressure and not by such factors as gravity, electrical or magnetic forces, and surface action.

A phase, P, is any homogeneous and physically distinct part of a system which is separated from other parts of the system by definite bounding surfaces. The number of components, C, of a system at equilibrium is the smallest number of independently variable constituents by means of which the composition of each phase present can be expressed, either directly or in the form of a chemical equation.

The number of degrees of freedom, F, of a system is the number of variable factors such as temperature, pressure and concentration, which need to be fixed in order that the condition of a system at equilibrium may be completely defined.

The phase rule has proved to be a valuable and necessary guide through the complications of systems for which data have been accumulated. For those who have been involved in the correlation, evaluation or the use of such data, no description is required as to the actual importance of this rule as a foundation for the entire de-

velopment of phase equilibria relationships.

The apparent simplicity of this general rule often prevents proper or adequate application of it. Apparent inconsistencies with experimental observations are due either to nonequilibrium conditions or to incorrrect designation of terms.

We want to emphasize that the phase rule applies only to a system in stable equilibrium and does not indicate the rate at which this equilibrium is attained. Although this rule is specific about the number of phases involved in the equilibrium, it cannot specify their nature, exact composition or total quantity. While you can predict that a certain number of phases will be present at a time for a specified temperature and pressure and that each phase will have one specific composition, you cannot predict the value of this composition.

Phase diagrams encountered in the metallurgical and ceramic fields may be very complex. They are usually of the temperature-composition type. A comprehensive discussion of the phase rule, phase diagrams and all their ramifications, is beyond the scope of this report.

However, to illustrate the significance of the phase rule, we will consider several relatively simple cases involving solids-gas contact.

The reaction involved in the calcination of calcium carbonate can be represented as:

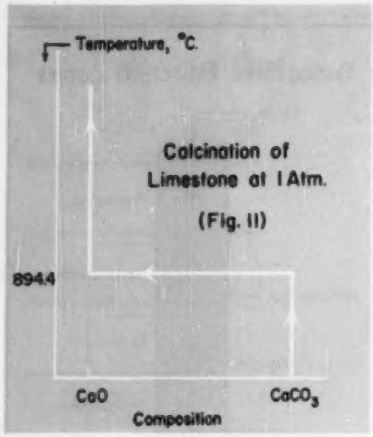
$$CaCO_3\ (s) = CaO\ (s) + CO_2\ (g)$$

This example of heterogeneous reaction is typical of many decomposition reactions involving the formation of a new solid and a gas.

The reverse reaction of a gas and a solid to form another gas compound is also widely encountered in oxidation and other reactions. In this example there are two solid phases, $CaCO_3$ and CaO, and one gas, CO_2. The number of components is two and can consist of any combination of the reacting compounds.

The thermal decompositions of many other compounds such as carbonates, nitrates, sulfates and salt hydrates also involve two components. For example, the reaction

$$FeCl_3 \cdot 12H_2O\ (s) = FeCl_2 \cdot 7H_2O\ (s) + 5H_2O\ (g)$$



involves $FeCl_3$ and H_2O as the simplest components.

The reduction with hydrogen of a metal oxide such as NiO to metal presents a somewhat more complicated equilibrium since we can define two solid phases in terms of Ni and NiO but a third component is required to define the gaseous phase mixture of H_2O and H_2.

In the above examples the gases always count as one phase regardless of the number of different species of molecules in the gaseous mixture. In general, each specific solid in a system is considered an individual phase provided it is involved in the equilibrium and is in actual contact with the gases.

For the decomposition of calcium carbonate to calcium oxide, the phase rule stipulates that at equilibrium there are three phases and two components.

$$F = -P + C + 2 = -3 + 2 + 2 = 1$$

The system is univariant. We are required to fix only one variable such as either temperature or pressure.

To define the system at each temperature, there is a correspondingly different maximum pressure of CO_2 (known as the dissociation pressure) which follows the same general law as the vapor pressure of a pure liquid. In this instance the dissociation pressure at any given temperature is independent of the relative amounts of the two solids and the total volume of the gas phase.

However, for equilibrium to be reached it is necessary for both solids to be in contact with the gas. Furthermore, at equilibrium at a given temperature, an infinitesimal increase or decrease in the pressure of CO_2 will cause the reaction to proceed to the right or left, respectively.

If we specify 1 atm. and 700 C., the phase rule indicates that any two phases may exist. Since the phase rule states the maximum number of phases, this number could be only one.

If a sample of $CaCO_3$ is heated batchwise under a constant total pressure of 1 atm. of CO_2, the solid composition remains unchanged as the temperature increases until we reach the dissociation temperature, 894.4 C. Here, another phase appears, CaO.

In spite of the continued addition of heat the temperature remains unchanged as long as the three phases exist.

$$F = -P + C + 2 = -3 + 2 + 2 = 1$$

Since the pressure is fixed at 1 atm., the system is invariant.

Once the $CaCO_3$ has been completely converted to CaO the temperature may again rise with the addition of heat (see Fig. 11). This fact is important in the design of continuous flow systems. It provides a true concept of driving forces.

We find similar cases in the decomposition of metal carbonates, nitrates and hydrates; the interaction of oxides with hydrogen, carbon monoxide and methane; the oxidation of sulfides and many others.

Note, though, that if the CO_2 in the calcium carbonate reaction is removed by a sweep gas as it is formed, the decomposition would occur far below 894.4 C. since the dissociation equilibrium depends only on the partial pressure of CO_2. In effect, a sweep gas reduces the total pressure.

An important industrial example of solids-gas contacting is the thermal decomposition of the hydrates of inorganic salts. For instance, extensive studies have been conducted on the isothermal dehydration of copper sulfate hydrates. There are at least three of these:

$$CuSO_4 \cdot 5H_2O = CuSO_4 \cdot 3H_2O + 2H_2O$$
$$CuSO_4 \cdot 3H_2O = CuSO_4 \cdot H_2O + 2H_2O$$
$$CuSO_4 \cdot H_2O = CuSO_4 + H_2O$$

We show data for these systems in

Fig. 12 at 25 C. Other temperature studies are available in the chemical literature.

It is unfortunate for practical engineering applications that most of the fundamental data made available from basic physical chemical studies were obtained at constant temperatures rather than the constant pressures that are normally involved in commercial chemical operations. Engineers often try to extrapolate isothermal data to isobaric applications as a rough approximation. This procedure is obviously unsound.

A proper representation of this system on three coordinates (temperature, pressure and concentration) requires a solid model. Isothermal and similar isobaric diagrams are simple projections or plane sections of the rather more complicated three-coordinate models.

Strictly speaking, equilibria data are significant only when all of the solid phases involved in the equilibria are known and specified. Much of the data previously published on such equilibria—even for relatively simple systems—are questionable because they fail to establish completely the nature of the solid phase.

Chemical Equilibria

The law of mass action postulates that the rate of a chemical reaction is proportional to the active masses of the reacting substances. This, in turn, has lead to the development of the classical law of chemical equilibria which may be derived simply as follows.

Consider a reversible homogeneous gas reaction

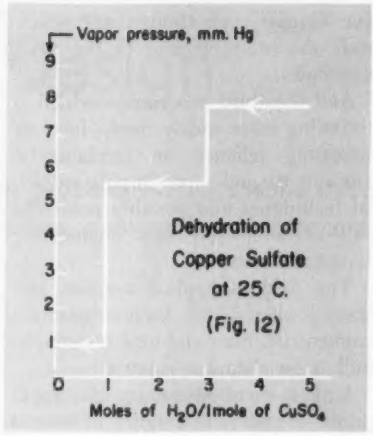
$$aA + bB = cC + dD$$

According to the law of mass action, the rate of this reaction is proportional to the active mass concentration of each constituent raised to the power of the number of molecules indicated by the reaction equation. The rate of the forward reaction is equal to the value of

$$kC_A{}^aC_B{}^b$$

and the rate of the reverse reaction is equal to

$$k'C_C{}^cC_D{}^d$$



At equilibrium the two rates are equal.

$$kC_A{}^aC_B{}^b = k'C_C{}^cC_D{}^d$$

$$C_C{}^cC_D{}^d/C_A{}^aC_B{}^b = k/k' = K_c$$

where K_c is the equilibrium constant in terms of concentrations.

If we use partial pressures, we substitute $p = cRT$ and get

$$p_C{}^cp_D{}^d/p_A{}^ap_B{}^b = K_p = K_c(RT)^{\Delta\nu}$$

where K_p is the equilibrium constant in terms of partial pressures; and $\Delta\nu$ is the increase in the number of molecules as expressed by the equation. If $\Delta\nu$ is zero, K_p equals K_c.

Another useful concept for many solids-gas reactions is the familiar van't Hoff equation

$$d(\ln K_p)/dT = \Delta H/RT^2$$

This represents the variation of the equilibrium constant with temperature for a reaction involving gases, in terms of the change in heat content, ΔH (heat of reaction at constant pressure). In integrated form this equation is

$$\log \frac{(K_p)_2}{(K_p)_1} = -\frac{\Delta H}{4.576}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

If we know ΔH from the heat of reaction at constant pressure, then we can estimate $(K_p)_2$ at any temperature T_2 if we know the value of $(K_p)_1$ at another temperature T_1. Often, this equation is used to calculate the heat of reaction from known values of K_p at two temperatures.

Consider again the dissociation of $CaCO_3$. The concept of heterogeneous chemical equilibria regards the "active mass" of both $CaCO_3$ and CaO as constant regardless of the amounts present. This eliminates these terms from the equilibrium constant and

$$K_p = p_{carbon\ dioxide}$$

At a given temperature K_p is a constant corresponding to a definite pressure of CO_2—a conclusion supported by experimental data. We can arrive at the same conclusion through the phase rule.

We consider the activities of solids to be constant because solids have relatively constant vapor pressures that are usually negligible compared to the pressure of the gases. Even though these solid vapor pressures are small they are nevertheless finite and important.

For example, reactions between two solids such as Ca and TiO_2 can go practically to completion even at temperatures appreciably below the boiling or sublimation points of any of the constituents present.

Such a reaction could not conceivably be produced other than by the reaction of vapors or vapors and solid. It is impossible to visualize each molecule of TiO_2 as being in immediate contact with Ca regardless of how fine or intimate the mixture of the two original solids is.

Here are some other examples of solids-gas reactions involving two solids and one gas:

• Conversion of a higher to a lower oxide by thermal decomposition. Lead is just one of many metals that undergo such a reaction. The equation would be

$$2Pb_3O_4\ (s) = 6PbO\ (s) + O_2\ (g)$$

• Conversion of an oxide to a metal by heating. One case would be the decomposition of silver oxide. The reaction can be represented by the equation

$$2Ag_2O\ (s) = 4Ag\ (s) + O_2\ (g)$$

• Decomposition of metallic amines.

$$AgCl \cdot NH_3\ (s) = AgCl\ (s) + NH_3\ (g)$$

In each of these cases there is a definite dissociation pressure of gas at each temperature that corresponds to a fixed value of K_p for the system.

An example of one solid and two gases is:

$$C\ (s) + CO_2\ (g) = 2CO\ (g)$$

where K_p is the partial pressure of CO squared and divided by the partial pressure of carbon dioxide.

An example of two solids and two gases is the dissociation of sodium bicarbonate:

$$2NaHCO_3\ (s) = Na_2CO_3\ (s) + H_2O\ (g) + CO_2\ (g)$$

where K_p is the partial pressure of water divided by the partial pressure of carbon dioxide.

Further examples of two solids and two gases that are in chemical equilibrium are:

$$FeO\ (s) + CO\ (g) = Fe\ (s) + CO_2\ (g)$$

where K_p is the partial pressure of carbon dioxide divided by the partial pressure of carbon monoxide; and

$$FeO\ (s) + H_2\ (g) = Fe\ (s) + H_2O\ (g)$$

where K_p is the partial pressure of water multiplied by the partial pressure of hydrogen.

We can write similar equations for the oxides of such metals as nickel, tin and cobalt.

It is very important to understand that chemical equations should always be written in conjunction with the equilibrium constant. The value of K_p for the reduction of FeO with hydrogen, as shown above, is:

$$K_p = p_{water}/p_{hydrogen} = 0.322$$

at 600 C. in the presence of Fe and FeO. For the reaction

$$CoO\ (s) + H_2\ (g) = Co\ (s) + H_2O\ (g)$$
$$K_p = p_{water}/p_{hydrogen}$$

but at 600 C. the value of K_p is now equal to 46 with solid phases of cobalt oxide and cobalt.

Kinetics

We can group investigations of chemical reaction kinetics into three general categories. All three are important to the chemical engineer interested in the design of moving-bed reactors. The first and only basically correct approach is that of the fundamental kineticist. The second is the completely empirical approach used by engineers who must provide operable designs even though not necessarily the most efficient or the most economical.

And the third procedure—which is becoming more widely used—involves increasing reliance on fundamental concepts to guide and simplify empirical techniques and possibly point the way to completely new engineering design methods.

The field of applied reaction kinetics is based on thermodynamics, momentum, mass and heat transfer, as well as on chemical kinetics.

Unlike thermodynamics the application of chemical kinetics to process design is in the embryonic stage. Very few examples are available of successful commercial scale-up from fundamental considerations of kinetics.

Except for a few relatively simple cases, it is not yet possible to formulate quantitative relationships for reaction velocities. Evaluations of experimental data are used as a general qualitative guide.

The recent monograph on "Reaction Kinetics in Chemical Engineering" by Olaf A. Hougen provides an excellent summary of the current status of the art. The extensive uses of pilot plant investigations are in reality monuments to our ignorance on the subject of applied kinetics.

Most rate equations used in reactor design are either empirical or approximate. Calculations based on rigorous theoretical developments of reaction kinetics, intermolecular forces and statistical mechanics are completely inadequate for the vast majority of commercial processes.

A typical empirical approach is to assign arbitrarily a number for a pseudo-simple order. Thus, for a pseudo-first order reaction.

$$k = k_o(1 - ax)$$

where k_o is the reaction velocity constant at the beginning of conversion; and a is an empirical constant. Some success has been reported in the adjustment of the velocity constant to the extent of conversion by arbitrary empirical modifications.

Another empirical procedure involves assigning apparent order numbers without regard for true orders. The purpose is to minimize the work involved in correlating kinetic data. This method is certainly not as sound as obtaining complete data for all desired conversion and concentration levels.

Similarly, in the development of complex chemical processes from bench-scale studies through pilot plant operation, chemical engineers generally devise graphical methods for the correlation of experimental data and their application to plant scale-up. Rate equations are not required. Performance charts, constructed to cover flexible conditions of operation, are designed to reduce difficulties and uncertainties of mathematical formulas. These are usually not published since they are normally considered company confidential.

There is no need to dwell here on the critical importance of chemical kinetics in industry. The kinetics of a system may control the yields and quality of product as well as the size and capacity of process equipment. The mechanisms—chemical and physical—of most catalytic and noncatalytic solids-gas reactions are so complex that the engineer must be satisfied with apparent mechanisms for practical design.

In spite of these limitations there has been considerable progress in the field of applied kinetics. While there is no expectation that detailed studies can provide realistic and economic designs—particularly for complicated reactions—it is often possible to establish over-all effective mechanisms based on a significant rate-controlling reaction.

Furthermore, in many of these operations the chemical reaction is so rapid that in effect it can be neglected. Often the rate-controlling factor involves the physical resistances found in fluid mechanics, heat and mass transfer.

The transfer of momentum, mass and heat by molecular motion, convection and turbulence are all closely related to rates of reaction. Flow patterns of gas and consequently, chemical conversions, mass and heat transfer are all influenced by reactor shape and the presence of obstacles such as heat exchangers. Many of the factors that we have mentioned may control the resistance for a system under given conditions. We may alter this by changes in temperature, composition, pressure or flow.

Engineering Design

I — COMMERCIAL OPERATION
II — FUNDAMENTAL CONCEPTS
III — ENGINEERING DESIGN
IV — NEW APPLICATIONS

The integrated design problem includes solid feed preparation, solids feeders, conveyors and reactors.

THE engineering problems pertaining to moving-bed processes should be considered as integrated design problems with due concern for all related or auxiliary components. Over-all design can be drastically altered by major changes in any of the component operations such as pelletizing, solids recirculation and heat transfer.

In this section we will discuss factors of major importance in process and mechanical design of moving-bed processes including:

- Solid feed preparation and solid characteristics.
- Solids handling feeders, conveyors and level measurements.
- Reactor designs.
- Miscellaneous factors such as temperature, pressure and instrumentation.

"Solid feed preparation is the key to technical feasibility."

It would be difficult to overestimate the importance of pelletizing or preforming for any proposed moving-bed application. Whether you call it size enlargement, agglomeration or particle consolidation, the production of a solid feed consisting of suitable discrete pellets, briquettes or compacts is certainly one of the most vital and perhaps the key factor in the adaptation of the moving-bed principle to any new process.

Whether or not the subject of size enlargement or feed preparation is designated as a new unit operation, it is certainly an art rather than a science because of the complexity of the physical and chemical factors involved. For a more complete discussion of the subject we refer you to the section in Perry's handbook and a previous Chemical Engineering Report (see *Chem. Eng.*, Oct., 1951, p. 161).

Organizations, such as the Houdry Process Corp., which have developed outstanding reputations in their ability to process a vast variety of materials into pelleted or compact form, have been guided to a limited extent by fundamental considerations. But mostly they have been guided by practical experience and empirical know-how.

Although theoretical considerations and extensive experience are invaluable in reducing the amount of experimentation required, there is still no reliable substitute for actual laboratory work and, preferably, full-scale testing of the materials considered.

In the table below we suggest a classification of commercial methods and equipment, although there are not always clear lines of demarcation among them.

The general importance of proper feed preparation is illustrated by the dependence of the entire future of our steel industry on the feasibility of pelletizing low-grade ores. In the recovery of iron from magnetic taconites the product is a very fine concentrate not suitable as a charge to blast furnaces.

An enormous amount of effort is being exerted on the development of suitable agglomeration or pelletizing methods not only on magnetic taconite but also on the nonmagnetic variety, jasper and other low-grade ores. Among the methods that have been proposed are: drum pelletizing followed by sintering in vertical kilns; and traveling-grate sintering of mixtures of coal and ore concentrates.

The finely dispersed iron minerals in the taconite and other low-grade ores are primarily responsible for the necessity of producing a very fine concentrate for suitable recovery. To avoid excessive dust loss and other problems in the blast furnace, these fines must be subjected to an expensive agglomeration.

However, the costs of the additional beneficiation and agglomeration are at least partially balanced by increased blast furnace output.

The problems inherent in the use of lower-grade iron ores and coke are of particular interest here because many of them are very similar to the problems involved in other applications of the moving-bed principle to solids-gas contacting processes.

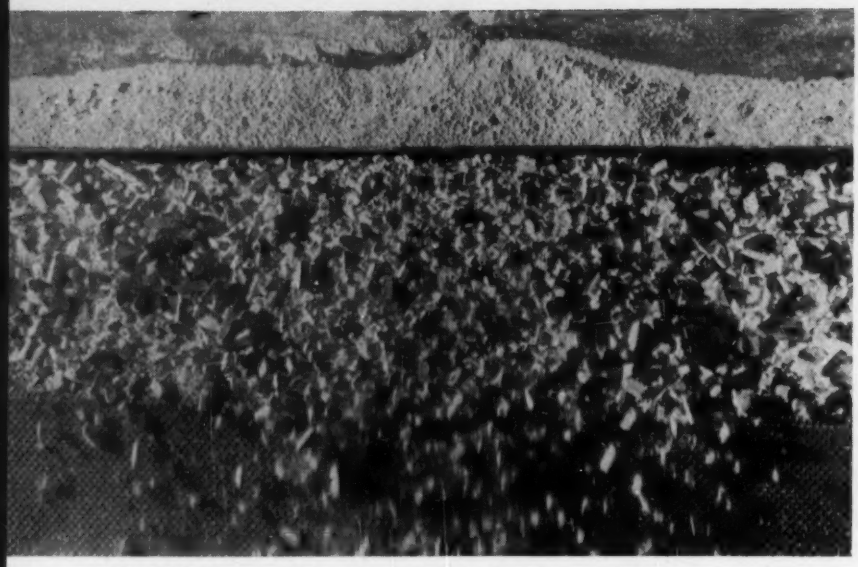
Since the time required to reduce a lump of ore is a direct function of its thickness and apparent bulk density, there is a distinct advantage in having as high a percentage as possible of more porous and permeable lumps of pellets.

These Solid Feed Preparation Methods Are Available

- **Sintering**
  - Continuous—rotary kiln and moving trays
  - Static—stationary sintering hearths
- **Tumbling**
  - Pelleting
  - Granulation
  - Balling
- **Pressure**
  - Tableting or pelleting
  - Briquetting
  - Molding presses
  - Preforming by pressing drums or filters
- **Extrusion**
  - Dies
  - Screens and plates
- **Spray or Shot Methods**
  - Gas medium
  - Liquid medium
- **Casting**

Sintering

The importance of metallurgical sintering operations in the preparation



PREFORMING FEED directly on Proctor & Schwartz filter—Fig. 13.

of pelletized feed for moving-bed type operations is illustrated by the development of low-grade domestic taconite ores. It is possible that many of the sintering operations might be better conducted by a moving-bed method. The possibilities here would even be further enhanced if the products of such an operation were designed for use in a subsequent moving-bed process.

The terms sintering, nodulizing, pelletizing, agglomeration, etc. when applied to operations involving partial or incipient fusion of the solid material or the added agent all pertain to the same general process.

Rotary and moving-bed sintering machines involve continuous movement between the solid and the equipment. In the stationary hearths discussed below, there is no relative motion of the two. Blast furnace flue dust, manganese dioxide and other ore concentrates, magnesite and dolomite all involve sintering operations.

The rotary method involves kilns or dryers which are used for cement manufacture, blast furnace dust, ores, phosphate fines, flotation concentrates and dolomite. Sizes of these units range from 1 ft. dia. by 18 ft. long to 18 ft. dia. by 500 ft. long. Temperatures may go up to 3,800 F. Larger units can process over 5,000 tons of solids per day.

Use of rotaries has been somewhat limited because there is a tendency for fused rings and scale to form. Rotary units are more economical when operated continuously.

The moving-tray unit has been built for capacities of over 1,500 tons/day. It is in essence a variation of the static method described above and has been used in the sintering and roasting of ores as well as in the cement industry. It is particularly well adapted to intermittent operations.

The static methods involve production of either random-sized sinters or briquettes formed with binders using pressure techniques. Typical applications are refractories, building bricks and tile, various ceramics and iron ore. They are somewhat more expensive than rotary methods.

Pressure Forming

Pressure forming operations are very important for moving-bed use because of the uniform size, shape and properties of the products. The industrial applications are very numerous. They range from briquettes of iron ore and coal to pharmaceutical pills. Uses in chemical, metallurgical and petroleum fields are undoubtedly familiar to most engineers.

Many operations such as conveyor drying, for which pressing or preforming methods are usually used as feed preparation, should be particularly suited to moving-bed applications—at least from the aspect of technical feasibility.

Preforming can be carried out by pressing material into grooved surfaces of internally heated drums where it is partially dried and discharged in the form of little sticks. An alternate method is to score the material on the drum of the filter and allow it to break at the discharge point into uniform lengths. Fig. 3 shows a typical unit.

Extrusion

Extrusion provides a method for forming discrete particles or shapes from a mass of material which has been plasticized with a liquid in a mixing operation. It involves forcing a relatively plastic mass through appropriate openings at a pressure consistent with the flow properties of the mass.

When strength and dimensions of the product are secondary, screens and perforated plates are used for pressing the plasticized mass. Dies are used for molding of the agglomerates on a large scale where relatively simple shapes and stiff masses are involved. Examples of the former are phosphate fertilizers and carbon black. Illustrations of the latter are catalyst pellets, clay and carbon electrodes.

The size and shape of orifices for both types are not predictable and must be determined experimentally. They are chiefly a function of the physical and chemical properties of materials at the conditions of extrusion.

Tumbling

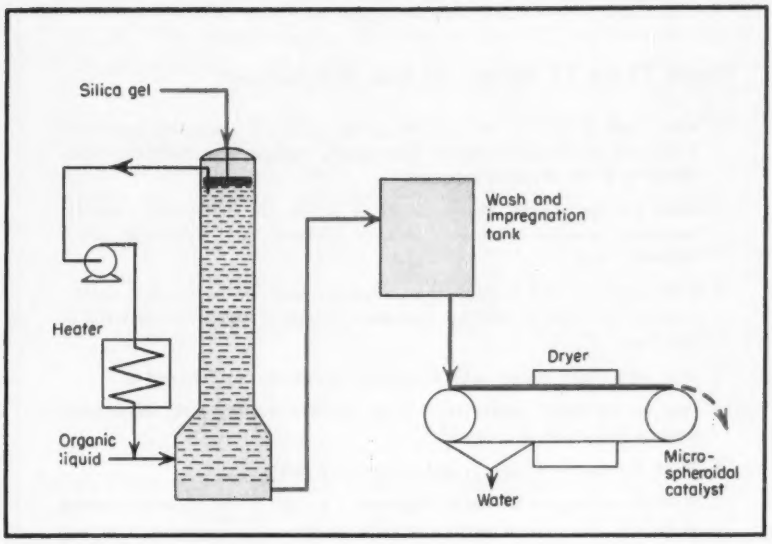
Size enlargement by tumbling includes the production of pellets, balls or agglomerates without the application of pressure, although binders and heat may be used. The categories of tumbling, pelleting, granulation and balling differ primarily in the use of binders, the manner of heat addition and the size and uniformity of product.

Granulation occurs in rotary drying processes when attractive forces (co-

hesion, surface tension, etc.) acting between particles are sufficient to withstand rolling treatment. Coarsely crystalline materials will not granulate but most fertilizer mixtures are sufficiently plastic when wet to granulate with little or no grinding.

For a uniform product, the average diameter of the final granules should be several times the size of the largest particle in the mixture.

Tumbling is widely used in the processing of fertilizers, coal and ores. You will need pilot-scale tests unless you have had extensive experience with specific materials. The products from this type of preforming could well prove suitable for many moving-bed operations.



SPRAY PROCESS prepares bead-shaped catalysts—Fig. 14.

Spray

Many unique and ingenious techniques have been proposed or studied for the formation of synthetic cracking catalysts. The spray method has attained considerable importance in the petroleum industry.

Spray methods involve the use of liquids or gases as the fluids through which material is dropped to achieve the desired shape, uniformity and other characteristics.

The sketch in Fig. 14 shows hydrogel droplets spraying through an organic liquid to form bead-shaped catalysts suitable for moving-bed operations. A number of variations of this technique have been patented including a procedure for the manufacture of silica-alumina and silica-magnesia microspheroidal catalysts.

One form of microspheroidal catalyst production involves mixing sodium silicate and sulfuric acid solutions. A slurry of $Al_2(SO_4)_3$ or $Mg(OH)_2$ is added, the mixture sprays through a nozzle into an oil bath, and the gel is removed after setting. Hollow spheres and special shapes can also be readily formed.

Selecting a Method

It is improbable that you will find only one pelletizing method for any given material. Before making a choice you should consider all the design factors listed in the table on the next page.

For systems with high rates of recirculation of solid pellets—as in catalytic cracking—there are relatively rigid specifications for abrasion, attrition, thermal and mechanical shock resistance and other physical properties. For pellets used in either a once-through or relatively limited cyclic operation, these specifications are much less stringent. It is desirable to minimize breakdown of the particles not only to prevent possible carry-over into the gaseous effluent but also to insure operation at a minimum pressure drop to avoid clogging auxiliary equipment. You should consider the range of temperatures, rate of solid recirculation and actual conditions to which the solids will be subjected.

Although preliminary tests can narrow the variables, evaluations must eventually be conducted on continuous, steady-state equipment to confirm the suitability of the pellets. Consideration should also be given to subsequent processing of the pellets after they leave the reactor, with a view toward simplifications and economies in further processing, recirculation or storage.

The mechanisms of the various pelletizing methods are many and complex. In sintering operations, partial fusion of one of the major constituents or the binder is the dominant factor. In most extrusion operations the pellets are fused into a homogeneous mass as in the case of plastics and the extrusion of hydrates of inorganic salts.

With pressure methods, binding agents may be required to implement mechanical interlocking of particles. Interfacial tension effects are probably the key factors in spray techniques.

In tumbling or other granulation methods—where a final pellet or briquette is obtained consisting of a mixture of individual and random particles—two basic types of cohesion may exist aside from possible chemical reactions:

- True cohesion.
- Apparent cohesion.

In true cohesion intermolecular or van der Waals binding forces are involved. Apparent cohesion results from surface tensions created between wetted particles through a vast number of tiny capillaries. In the latter case, wettability, distribution and size of capillaries, as well as surface tension may be altered by various methods to increase amenability to pelleting.

Various means for controlling hardness of pellets or briquettes have been developed. Important factors include: selection of conditions of formation of components and their admixture; control of moisture content in extrusion, casting and other methods;

Check These 11 Factors in Size Enlargement

1. What kind of reaction is involved in the solids-gas contacting operation? Is the solid present as a catalyst, heat transfer medium, or permanently transformed to a new chemical compound?
2. What are the physical characteristics of pellets for moving-bed operation, including: abrasion resistance, hardness, thermal and mechanical shock resistance, etc?
3. If the solids are used as catalysts or adsorbents, what are their surface characteristics? This includes make-up requirement because of deactivation or break-up into fines.
4. What about size, shape, density, chemical reactivity and deformation?
5. How do the pellet properties vary in porosity; stability with temperature, pressure and chemical changes?
6. What is the desired capacity and recirculation rate?
7. Is there a subsequent storage or treatment, a possible further chemical reaction of the pellets, a recirculation or crushing, etc.?
8. What are the investment and operating costs?
9. Are the pellets stable and consistent under operating conditions?
10. What are the requirements for the final product from the reactor?
11. What are the abrasion limitations for various parts of the system?

and proper choice of drying and other conditions.

Solids Flow Control

Solids flow control is a very critical factor in the design of any moving-bed system. This section summarizes the more widely used solids feeder equipment available to the chemical engineer and emphasizes those that have been or might be particularly adaptable to moving-bed operations.

Naturally, wherever solids are involved we have accessory equipment such as hoppers and bins that require discharge mechanisms. The term feeder applies to control mechanisms at either the inlet or exit end of a reactor.

In the table below we present a list of typical solids feeders with comments on their characteristics and suitability. The most comprehensive article available on this subject was published by T. R. Olive (*Chem. Eng.*, Nov. 1952, p. 163).

Most of the solids feeders discussed here have been used for various applications in the petroleum and metallurgical industries. Many companies have evolved and patented novel innovations of principles involved in these units for a wide range of conditions of temperature, corrosion, solids flow characteristics, erosion, pressure and special hazards.

The problem of selecting a solids feeder is usually resolved by somewhat arbitrary decisions based on individual experience with a few specific types. Seldom is only one type suitable from the point of view of either technical feasibility or cost.

A systematic approach to the problem involves close integration of the feeder mechanism with:

- Preparation of the compact pellets or briquettes used as feed to the moving-bed unit.
- Conveying equipment.
- Anticipated temperature, pressure, corrosion, gas leakage and other conditions in the region of the feeder.

The selection and design of these feeders is still very much an art and a great deal of experimentation and vendor service work are usually desirable for new applications. Organizations that have broad experience and special know-how in pelleting, briquetting and preforming a tremendous variety of solid materials into discrete shapes, have also of necessity developed competence in the selection and design of solids feeders and conveyors. Among the problems encountered in feeder design are bridging, flooding, material sticking to the sides of the container, feeding against pressure and vacuum, gas seal, temperature, corrosion and erosion.

Related problems are the design of bins, hoppers and their discharge devices. Space does not permit us to discuss bin design, methods of combating bridging, use of oscillators, agitators, vibrators, gas-injection devices, etc. Considerable data are available from the vendors of such equipment.

Much of what we have said about solids feeders also applies to bin discharge. The handling and storage of pellets and similar discrete material is generally much simpler than for powder or sticky material.

Solids Conveying

The technique used for solids conveying operations outside of the reactor proper is always a major factor in the over-all design of a moving-bed installation. It is a particularly critical consideration for operations that involve tremendous recirculation rates as in the catalytic cracking of petroleum hydrocarbons.

The two methods most widely used for moving-bed applications in the petroleum industry are pneumatic lifts, such as Houdriflow, and bucket elevators. Both operate primarily as elevators for recirculation of solids to the top of reactors.

The table on p. 194 gives a list of typical solids conveying equipment with some comments on their applications. Two recent comprehensive references are available on this subject: a book by W. Hudson, "Conveyors and Related Equipment"; and a report by A. Strube, "Conveyors and Elevators". (*Chem. Eng.*, Apr. 1954, p. 195).

Although there are many theoretical considerations, over-all designs of solids-conveying equipment are still basically empirical in nature for specific conditions and properties of materials involved.

Many types of conveyors have been proposed and studied in the petroleum industry. The number and variety used in the chemical and

metallurgical fields is also very large. Without a doubt many of them should be reconsidered for new moving-bed applications. This is particularly true because most moving-bed applications will involve relatively little recirculation compared to petroleum practice.

Furthermore, physical and chemical properties of the solids involved in new applications are often inherently different from those previously encountered in moving-bed operations.

Among the other types of elevator conveyors that should be considered are: flight, skip hoists, vibrating units, pivoted bucket carriers, belts, continuous flow equipment, apron and belt, screw or ribbon, batch elevators and dense-phase upward flow.

For a once-through chemical operation, the relative importance of the conveying system—as a fraction of the over-all investment—is far less than in the case of catalytic cracking of petroleum. It is common practice with catalytic cracking units to circulate many hundreds of tons of solid catalyst pellets per hour.

The selection of a conveying system for new applications should be based not only on cost considerations but also on thorough test data from vendors.

Although basically new conveying schemes might be designed, this procedure would rarely be justified except for operations such as petroleum cracking. One form or another of the wide variety of standard equipment available should be found suitable for practically any chemical or metallurgical operation.

Solids Level

Among the important instrument applications involved in most moving-bed operations are units for the measurement and control of solids level. Because of its importance to engineering design, much progress has been made in this field by instrument manufacturers as well as by the petroleum industry.

A thorough survey of "Process Instrumentation" was published recently (*Chem. Eng.*, May 1952, p. 161).

The engineer now has available to him a broad selection of automatic devices to incorporate into moving-bed designs. The choice should be based on such factors as: the particular application (storage bin, hopper or reactor); high- or low-level indicating or control; requirement for indicating, alarm, recording and control; investment costs; precision required; instrument maintenance; temperature, pressure and corrosion characteristics of the system; and special hazards.

Gamma Ray—Solids level detection is based on a radioactive source mounted inside a vessel, with a radiation counter on the outside. As the solids level rises in the vessel, the solids absorb gamma rays and decrease the output detected by the radiation counter. Absorption of gamma rays depends on the density of the solids and the length of path through the solids.

Are particularly advantageous in that no openings in the reactor or container are needed.

Flexible Diaphragm—Mounted in

Solids Feeders for Consideration in Moving-Bed Designs

	Characteristics	Applications
Rotary Star Feeder	Many variations are used: star, spiral pockets, rotary lock, vein, drum, etc. Can serve as feeder measurement and proportioning device. Capacity is easily adjusted by varying rotation speed.	Well suited for pellets and other discrete particles of type used in moving-bed. Used for free-flowing materials in general, but not satisfactory for abrasive conditions.
Rotary Table Feeder	This unit functions by taking advantage of the natural tendency of pellets to seek their angle of respome, and thus block discharge above the rotating table The rotation upsets this condition and causes flow in proportion to speed of rotation. Mechanism may be based on vibratory motion rather than rotation.	These have found intensive use in moving-bed units. Variations of this principle are used for even sticky materials with skirt boards.
Screw Feeder	Capacity is varied by altering speed of shaft. There are many variations of these, open, enclosed or jacketed. They may also be designed with a hollow shaft for heat transfer purposes.	Widely used for granular and pulverized materials such as chemicals, fine ores and cement. Also well adapted for handling pellets and pebbles, possibly together with other measuring or control mechanisms to convey solids from one reaction zone to another.
Disk Type Flow Valve	Solids disengaged over a circulation disk with a disengager in the valve body releasing surges of gases which flow down through a seal leg above the valve to provide constant solids flow.	Moving-bed processes.
Slide Valve	Simple device, the operation of which is based on variable opening thus determining rate of flow.	Used mostly in fluid cracking although it might be applied to moving-bed processes.
Vibrating Feeder	Consists of chute vibrated mechanically or electrically and may be open, enclosed or jacketed. Very versatile and suitable for elevated temperatures.	Can be used for either sticky or free-flowing material.
Reciprocating Plate Feeder	Mechanism for control of flow of granular solids and also used for uniform flow distribution over the cross-section of a reactor or hopper. Involves moving tray with multiple downspouts and one or two stationary feed trays. Capacity is a function of length and number of strokes.	Used for moving-bed applications and for handling lumpy material such as coal. Not suitable for sticky solids. Used in Hypersorption and Hyperforming design.
Plug Valves	Involves spring loaded seats.	Used in some catalytic cracking units.
Piston Feeder	A piston displacement device with reciprocating mechanism. Capacity is function of length of stroke.	Moving-bed operations involving upward flow of solids.
Flight Feeder	Very versatile.	Can be adapted to many types of materials, hot, corrosive, dusty and sticky.
Fixed Feeder	Proportioned flow in adding one solid to another in a bed.	Addition of fresh catalyst to moving beds in petroleum operations.

Solids Conveyors and Elevators

	Characteristics	Applications
Bucket Elevator	Used in moving-bed applications in the petroleum industry. Limitations of circulation rates and mechanical problems involved at very high temperatures were instrumental in replacement of these units by pneumatic devices in new TCC installations.	Versatile for a wide range of temperatures, type of solids, abrasiveness, corrosion, etc. Mechanically efficient.
Pneumatic	Basically a simple gas lift device utilized in moving-bed applications to circumvent limitations of temperature level and circulation rates involved in bucket elevators. Also widely used in fluidized solids transport.	Basis of Houdriflow and TCC gas lift processes.
Flight	Endless chains to which are attached spaced flights. Trough may be enclosed. Incline of 30–45° may be used, speeds of 25-200 feet per minute. Redler, drag, tubular and other en masse conveyors are variations of the flight technique.	Very durable and can be used for hot and corrosive materials. Many variations have been designed for specific applications
Upward Dense Flow	Essentially an upward flowing moving-bed involving the movement of particles as a dense settled mass. No particular advantage for once-through or limited circulation uses. High differential pressure required to move solids.	May prove competitive with gas lift and bucket elevators for some petroleum applications. Very little data available on plant scale use.
Apron and Belt	Large capacities possible. Maximum inclination about 30°, thus suited to limited recirculation if they also serve as elevators. Often utilized to convey solids from reactor or hopper to other elevators. Well suited as feeders for many operations.	Many varieties of design in commercial use for all types of materials from ore lumps to finely divided materials. Above 250°F steel apron types can be used Can be designed for hot, abrasive and corrosive materials.
Screw or Ribbon	Consists of steel helices mounted on spindles and suspended in trough. Normally on a horizontal plane and usable for practically all types of materials. Incline of 30° may reduce capacity 50% over horizontal. Not suitable for high rates of solid recirculation but may find use for once-through operations in chemical and metallurgical processes.	One of most simple and versatile types of material handling equipment. Can be designed for horizontal, inclined or vertical flow. Widely used for coal, gravel, sand, ores and many other applications.
Vibrating	May be used as feeders or for small inclinations, in conjunction with other elevator devices in moving-bed installations. May be mechanically or electrically activated.	Material must be dry for feeder or conveyor use. Demonstrated excellent performance for wide variety of conditions and materials, both open and enclosed.
Skip Hoist	Consists of buckets raised, dumped and lowered by cables attached to winding machine. Variable speeds may be intermitten or continuous. Few moving parts and low maintenance.	Good for corrosive, abrasive or hot materials of all types.
Batch Elevators	Any type of portable container, where continuous elevator methods may not be desired or justified in chemical moving-bed operations.	For extremely small scale operations, for relatively expensive materials or those with special properties.

the wall of a vessel and moves if contacted by solids, thus actuating a switch. When the level falls a spring or air pressure returns the diaphragm and switch to its former position. It can be located at intervals to operate alarms, indicators or controls.

Rotating Paddles—A paddle is rotated by a motor which is mounted so that as the paddle contacts solids, the torque produced is registered and converted to an indication of level. Can serve to indicate top level or to function as an alarm or feeder control.

Pendant Cone—An inverted cone is suspended from a rod in a housed switch. Any movement of the cone from the vertical position when contacted by solids is detected by the switch. They can function as alarms, indicators or controls.

Balanced Paddle—Paddle or horizontal arm extending into vessel through a diaphragm seal is balanced by a pneumatic transmitter. Solids contacting the paddle unbalance the arm and this indication is transmitted to a control unit. Characterized by rapid response.

Slack Detector—A small weight on a cable is lowered periodically into a vessel. When the weight strikes the solids level, the slack on the cable is indicated and a cycle-controlled winch reverses the cable. Cycle repeats so that the level corrects for each cycle.

Weighing Vessel—Total weight of vessel and solid contents are reported. Knowing the vessel weight and diameter, a very accurate determination of solids level is possible. Limited in use because of prohibitive cost, the use of strain-gage weighing may prove economical for certain applications.

Mechanical Probe—A vertical rod is mounted in a switch. Deflection of the rod actuates an electric switch and indicates level. Can be used for alarms, indicators or controls.

Grid Response—A grid consisting of thin metal rings is connected by rods to form a vertical cylinder. Insertion of the grid into moving-bed of solids (application restricted to continuously moving bed of solids) measures the internal forces related to density of material and solids level. Grid element connects to a torque tube and a pneumatic transmitter.

Miscellaneous Electrical Units—Characteristics such as electrical conductivity and dielectric constant of the solids are used to measure solids level. A probe is inserted in the vessel and solids contact with the probe either completes an electrical circuit or affects capacitance of the circuit.

Reactors

There are many factors involved in the design of solids-gas contacting reactors. Their relative importance varies with type of reactor and conditions of operation.

In this section we will outline a few of the outstanding features of moving-bed or shaft reactors that have been or are now used for: blast furnace reduction of iron ore; cement and lime manufacture; and metallurgical roasting. The earlier section on commercial operation outlined some of the important features of reactors used in petroleum refining.

With so many important and potential rate-controlling factors to consider, most designs are developed from practical considerations in a more or less empirical manner. Usually there is a progressive scale-up

of equipment from bench-scale through pilot plant and often through semi-works.

Tradition plays an important—and often a dominant—part in the development of new or improved techniques. This is illustrated by the classical shapes and dimensions of many of the furnaces and roasters used in the metallurgical industry, including equipment such as blast furnaces, rotary kilns and rabble hearths.

A number of design factors are established by process specifications for: product purity; scale of operation; continuous or batch processing; type of reaction; temperature and pressure; possible radiation, health or other hazards; and the general philosophy of design.

Other factors to consider in the design of a reactor are:

- Flow of solids and gas.
- Shape and dimensions of reactor.
- Method of introducing and removing solids.
- Method for maintaining uniformity of solids and gas flows in reactor.
- Measurement and control for solids handling including conveying, feeding and quality control.
- Distribution and disengagement of gases.
- Separation and recovery of solids from gases.
- Use of seal legs and similar techniques for isolating reactor gases.
- Purging or desorbing gases from solids removed from vessel.

Lime

In Fig. 2 on p. 176 we have shown a modern gas- or oil-fired moving-bed lime kiln. It has five zones: cooling, finishing, calcining, preheating and storage.

A typical unit might consist of a steel encased refractory shell 10- to 24-ft. dia. and 35- to 75-ft. high. Kiln feed is usually taken to the top by cable-drawn cars. The trend in design of these shaft kilns has been towards larger capacities, center-burner kilns, either oil-or gas-fired furnaces. Practically all are continuous.

There have been many engineering modifications of these kilns, particularly in conjunction with different fuels such as oil, blast furnace and producer gases. In some cases solid fuel is added with the charge; lime is then removed with ashes.

The interior design of the modern shaft lime kiln provides for suitable fuel and air distribution to insure adequate calcining and cooling. The chief advantages of these kilns over rotaries are greater operational flexibility, higher thermal efficiencies, lower fuel costs and smaller capital investment.

Cement

There is renewed interest in the use of moving-bed kilns for the production of portland cement in the United States. Improved designs have been suggested using conical-shaped shells to allow for contraction of the charge during burning.

Additional improvements include more efficient feed preparation by pelletizing raw material on whirling drums. The future possibilities in this field are contingent on the use of the best available technology for the design of efficient economical shaft kilns and accessory equipment.

Blast Furnaces

A typical modern blast furnace used for reducing iron ore to pig iron is shown on p. 165. A moderate sized unit might be about 20-ft. dia., 90- to 100-ft. high, handling a feed of 1,200 tons of iron ore, 600 tons of coke and 250 tons of limestone to produce 600 tons of pig iron per day.

Purity, size and strength specification for coke are rigid. Coke not only serves as reducing agent and fuel but also supports the entire charge as a permeable mass.

The furnaces are refractory-lined steel shells. The refractory material (a fireclay brick) must be designed to resist mechanical abrasion, fluxing at high temperatures and the effects of strongly reducing atmospheres.

A hard, dense, superduty fireclay brick is used in the hearth and bosh sections. A water spray cools the inwall or middle section from the outside of the steel shell. Since the highest temperatures are attained in the upper section of the crucible and the lower part of the bosh, hollow metal cooler plates are set in the brickwork in these sections.

Blast furnaces of similar design are used for the manufacture of phosphoric acid and phosphorus by reaction of phosphate rock, coke and sand. The blast furnaces used for copper and lead, typical of those used for other nonferrous metals are basically different in many respects from the iron blast furnaces.

Side and end walls of lead blast furnaces consist of steel plates through which cooling water circulates. The inside of the crucible is lined with refractory and the outside supported by steel bracing. Height and width of these furnaces are about equal; length is variable. Over-all size is much smaller than the iron furnace.

Multiple hearth roasters have replaced many of the small blast furnaces used for smelting copper and lead ores.

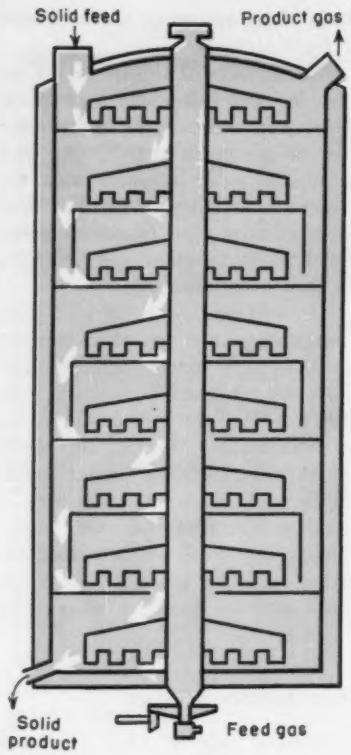
Miscellaneous Roasters

Multiple hearths (Fig. 15) and moving trays (Fig. 16) are among the more commonly used methods for the metallurgical roasting operations discussed in this report. Improvements and economies for many such operations are possible by replacing them with new or improved techniques.

Among the chief disadvantages of the fluidized-bed and flash methods which limit their application to metallurgical operations are: short retention time, the difficulty of even approaching countercurrent conditions and the tremendous amounts of solids entrained in the gas streams. These factors are precisely the characteristics that distinguish the moving-bed method.

Flash roasters were developed from observations that most of the reactions in multiple hearth furnaces occurred as solids dropped from hearth to hearth. The flash roaster has many features in common with fluidized-solids furnaces.

Continuous vertical shaft kilns with baffles or trays, rotating plows and a central vertical shaft, have been built in sizes of over 35-ft. dia. and 60-ft. high. There are many variations in size and design of such units. They are also known as rotary shelf dryers with a number of characteristics that are basically similar to



Multiple hearth furnace—Fig. 15.

moving-bed units such as: extreme operating flexibility and variable retention time.

The general flow of gases in these rotary shaft kilns may be concurrent or countercurrent to the solids. Capacity depends partly on the rate of rotation of the plows or shelf but primarily on the characteristics of the materials to be dried.

One of the most widely used multiple hearth furnaces is the Nichols-Herreshoff consisting of perhaps 12 hearths and a top drying section. This type of furnace contains a number of circular horizontal hearths, a steel shell supporting the hearths and a central rotating shaft carrying the rabble arms.

The Wedge roasting furnace is characterized by a central air-cooled shaft of sheet steel. The diameter is designed to permit replacement of rabble arms and blades through the shaft. Rabble arms are water cooled and provided with cast-steel breech blocks. This permits quick removal and replacement of the arms without hampering furnace operations.

There are many other vertical roasters of the multiple hearth type and others with ingenious designs for moving solids continuously through baffled shaft kilns. Many of them have been developed from operating improvisations. However, we believe that modern moving-bed techniques will prove more efficient and economical for many applications.

Petroleum

Tremendous strides have been taken—in a span of only a few years—in the design of moving-bed reactors for the petroleum industry.

Any attempt to cite all important engineering features studied, used and designed for pilot and commercial units would be extremely voluminous.

The technology that has been developed in the petroleum industry certainly warrants careful consideration when analyzing existing as well as future solids-gas contacting operations.

Miscellaneous Design Factors

In addition to the fundamental concepts discussed earlier, important features in the design of moving-bed processes are temperature, pressure, corrosion, erosion, solids properties, instrumentation and general design philosophy.

Most of these are related independent variables. For instance, we cannot discuss temperature without heat transfer, kinetics and fluid mechanics. Similarly, solid characteristics are related to such factors as kinetics and feed preparation.

It would not be realistic to generalize on any one of the huge variety of variables encompassed in moving-bed operations. Each application must be considered on its own merits taking advantage of all available tools, techniques and engineering know-how.

Temperature

In many cases, reaction rates increase in direct proportion with temperature; and maximum rates correspond to highest attainable temperatures.

Maximum rates are limited by: physical and chemical characteristics of solids and reactant gases; possible undesirable side reactions; transfer of large amounts of heat over short periods of time; fabrication of suitable refractories, engaging and disengaging devices for gases and solids; design of elevators for recirculating hot solids; proper provision for thermal expansion and contraction of equipment.

There are many instances where increased temperatures result in diminished reaction rates. The decrease of equilibrium constant with increase in temperature may more than offset the increase of the reaction velocity constant. Thus, we may get an overall reduction in reaction rate.

Indeed, the reaction may be reversed if the temperature is sufficiently high.

In moving-bed operations, temperature is particularly significant since precise temperature profiles or gradients can provide optimum results.

Pressure

Absolute pressure, pressure differences, gas leakages and pressure drops are all important factors in the design of moving-bed equipment.

High pressures increase fabrication costs. Maintenance of pressure differences between vessels requires either mechanical devices or seal legs. The mechanical methods include continuous or intermittent valves and pressure chambers. Seal legs function by pressure drop of fluid which flows through an appropriate length of leg at a rate that produces the desired pressure differential.

Materials of Construction

The material to be used for construction is a vital subject that often determines the over-all feasibility of a proposed process.

Reliable information is usually attainable only from actual performance data, preferably on a large scale simulating proposed plant operations. This applies to erosion, corrosion, chemical resistance, thermal and mechanical properties of metals, ceramics and other materials.

The many process variables that we have discussed up to now have an important bearing on the selection of suitable materials. Final choice will

naturally be based on the most economical of usable materials.

New developments in metals and ceramics are constantly extending the range of operations to higher temperatures, pressures and severe corrosive environments.

Solids Properties

We have already discussed solids properties in conjunction with feed preparation methods. The most important factor here is whether the operation requires large recirculation rates (as in the catalytic cracking of hydrocarbons) or little or no recirculation (as in drying, halogenation or reduction of inorganic compounds and ores.)

Other important criteria are: size and size range of solids, resistance to mechanical and thermal shock, general attrition characteristics, ease of deactivation or poisoning in the case of catalysts, change in surface area in the case of adsorbents and specific heat where heat retention is wanted.

No general predictions about allowable attrition or other factors are possible without specifying the operation, or at least the type of process.

Changes in operation or design of one critical part of a moving-bed system (such as temperature level, heat transfer or solids circulation method) can drastically alter requirements for solid properties throughout the operation.

Instrumentation

Process variables are conditions or states of a material or its environment which are subject to change. Each process must be analyzed separately to ascertain what these process variables are and the minimum number that require separate control.

Many of them are dependent variables which are indirectly controlled by others. Final decisions on the choice of controllers, indicators and recorders are usually based on considerations of suitability, accuracy, reliability and cost.

Instrumentation is just as important in chemical and metallurgical processes as it is in the petroleum field.

Space does not permit more than a very cursory discussion of this vital subject. Suffice it to say that instrumentation has come to be regarded not as a separate or auxiliary operation, but as an integral part of modern continuous processes.

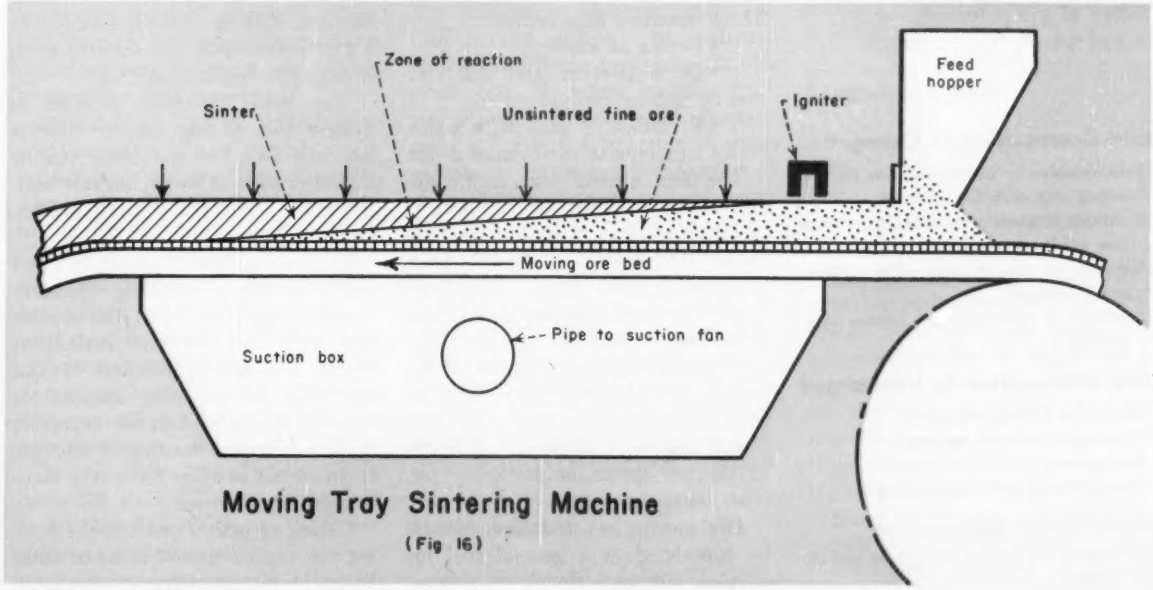
Naturally, the degree of refinement of automatic measurements and controls becomes a matter of engineering economics and must be justified in terms of improved product quality and minimized operating problems.

Design Philosophy

Actually, the predominant variable in determining the cost of a moving-bed or other type of installation is the over-all engineering design philosophy. This varies considerably depending on the industry, locale, amortization schedule, etc.

In some installations, spares of pumps and tanks are held to a minimum. Gravity flow is used extensively. Units are not enclosed. Inexpensive materials of construction are specified. Capital investment is held to a low value in spite of higher maintenance and other operating costs. Conversely, other designs for basically similar operations may specify stainless steel wherever possible. They may specify excessive spares on turbines and motors, well-paved roads and many extra provisions.

Thus in translating the general moving-bed or shaft principle from one industry to another, it is important to develop technical and cost data for each specific case. This makes it mandatory to proceed with care in the interchange among various industries of such items as: design procedures, estimates of investment and operating costs, labor and maintenance requirements, instrumentation and batch operations vs. continuous operations.



Moving Tray Sintering Machine
(Fig 16)

New Applications

Consider these possible applications of the moving-bed principle to your chemical and metallurgical operations.

It is not possible to conceive of any known solids-gas contacting method as being completely satisfactory in all respects and universally applicable to commercial operations.

Similarly, it would be unreasonable to expect that any of the innumerable commercial solids-gas contacting operations can be conducted by only one method.

The listing below presents categories of operations considered amenable to moving bed contacting methods. Examples will be presented here of basically new moving-bed processes in addition to others that have been previously suggested or conducted on a laboratory or pilot-plant scale.

New developments in some of the important applications of moving-bed techniques to nonpetroleum industries (such as blast furnace smelting of iron ores and the calcining of calcium carbonate) are also discussed. Our emphasis here is placed on chemical and metallurgical applications because there is little doubt that the petroleum industry will take full advantage of the potentiality and versatility of moving-bed techniques.

Solid Composition Is Changed

- Decomposition or volatilization by thermal means with evolution of gases
- Reactions of gases with solids to produce new solid compounds
- Reactions of two or more solids to form new compounds
- Reactions of solids to form volatile compounds

Solid Composition Is Unchanged

- Adsorption of gases on solids
- Regeneration of solid reactant
- Heat transfer
- Heterogeneous catalytic reactions

Solids-Liquid Applications

- Continuous ion exchange, leaching and extraction

It is not intended either that the illustrations of moving-bed operations will necessarily prove more economical than all alternate methods or that the possible applications are limited to those cited. Preliminary cost estimates could readily be made for most of these processes but they would have little or no significance without comparable evaluations of alternate solids-gas contacting techniques.

The important applications of the moving-bed principle to operations in the petroleum industry have been discussed or referred to previously. They include: catalytic cracking, reforming, thermal coking, shale retorting, separation of gases by adsorption, regeneration of pellets from cracking or adsorption operations and heat transfer.

Solid Composition Is Changed

The application of moving-bed techniques to reactions where the solids undergo permanent chemical change include many operations. Those discussed here include:

- Drying of solids.
- Decomposition and volatilization by thermal means.
- Reactions of gases with solids.
- Reactions of two or more solids.

The term "drying" used in this discussion is intended to comprise a broad category of operations that includes the removal of liquids from solids by thermal means, decomposition of inorganic compounds and ores containing chemically-bound water and the simultaneous removal of hydrogen plus hydroxyl groups from organic compounds. This terminology should also be considered applicable to similar operations involving solvents other than water.

The moving-bed technique should be considered as a general tool for carrying out such drying operations. The table below presents typical decomposition reactions which have been or probably can be demonstrated to be technically feasible. Note that this classification includes calcination and other thermal decomposition operations in addition to drying. In many respects the mechanisms of the two groups are very similar.

Drying or Dehydration

- Sodium sulfate
- Nickel sulfate
- Aluminum sulfate
- Ammonium nitrate
- Ores
- Calcium carbonate
- Clay
- White lead
- Lead arsenate

Thermal Decomposition

- Metal carbonates
- Metal nitrates
- Metal sulfates
- Metal sulfites
- Metal sulfides
- Metal chlorides
- Metal oxalates
- Ores
- Volatilization operations
- Miscellaneous organic compounds

Roasting processes in metallurgy commonly include drying as one phase of an operation which may also involve oxidation, reduction, halogenation, sulfatization, etc., with solid phases as products. The term "smelting" is used to designate operations in which a solid material—ore, concentrate, flux or fuel—is charged to a pyrometallurgical process with products in the liquid state.

The term "calcining" is used to denote the driving off by heating not only CO_2 but also other volatile materials such as water, organic matter, sulfur, SO_2, NO_2, metal halides, etc.

In many instances where the feed for a roasting or smelting operation consists of pelleted solids, the production units may function initially as dryers. The moving-bed principle can often be advantageously adapted for separate drying operations, especially if the subsequent roasting or smelting is conducted in some form of a vertical shaft-type furnace.

Drying of pellets involves the heating and vaporization of water or other liquid in the interstices of the solid,

or the decomposition of chemical compounds such as inorganic salt hydrates or complex ores. Possible rate-controlling mechanisms include: capillarity (due to surface tension effects); gravitational and frictional forces; vaporization within the pellets; and diffusion of vapor through the pores and through gas films about the pellets.

By varying conditions for a given system it is often possible to alter radically the rate-controlling factor from one of diffusion to that of capillary forces.

There are many chemical decomposition reactions which are basically very similar to drying in terms of solids-gas contacting. They include: the decomposition of salts with chemically bound water, such as $Na_2SO_4 \cdot 10H_2O$; decomposition at elevated temperatures of complex compounds found in clays and ores involving release of chemically-bound water, CO_2 and other gases; decomposition or calcination of metal carbonates such as $CaCO_3$, $FeCO_3$ and $MnCO_3$; decomposition or roasting of metal sulfates ($ZnSO_4$), metal chlorides ($FeCl_3$), metal nitrates [$Mn(NO_3)_2$] and metal oxalates; and the removal of impurities by volatilizing certain oxides, such as SO_2, SO_3, As_2O_3, Sb_2O_3, TeO_2 and SeO_2.

In addition to the physical properties of the solid pellets required to withstand thermal, mechanical and chemical effects in the reactor, there are certain required properties of the feed that are established by reactions preceding and following the drying or decomposition operations.

Therefore, in many metallurgical operations drying may precede a sulfatization or halogenation operation. The product from this may be leached to separate water-soluble constituents. This may be followed by a drying step and subsequent decomposition to produce metal oxides which, in turn, may be reduced to metal.

Many simplifications and economies can be achieved by integrating two or more of these operations into one continuous moving-bed process.

Metal oxides may be chemically converted by a salt roast to produce metal chlorides, which are then volatilized or decomposed.

There has been considerable interest in recent years in developing new processes for varied commercial metallurgical operations such as: drying of ores, concentrates and nonmetallic minerals; calcination of salt hydrates and metal carbonates; roasting of magnetic iron ore; selective calcination of magnesium carbonate to oxide without converting the calcium carbonate in the dolomite; and various oxidation, reduction and similar operations. Many of these processes involve the reaction of solids with gases and/or other solids.

The term "roasting" has a very broad connotation in the metallurgical industry. In general, it encompasses operations whereby an ore is heated under such conditions that the metal compound is usually changed chemically to a form amenable to subsequent processing.

Thus, roasting includes such varied reactions as: drying; volatilization of impurities and binding agents; formation and decomposition of chlorides, sulfates, sulfites, oxalates, fluorides and nitrates; oxidation, reduction and sintering.

We can cite many other examples but space permits us to discuss only a few. The advantages of incorporating many basically simple techniques into the design and operation of modern moving-bed kilns provide the most simple and economical—yet the most versatile—furnaces and kilns.

Among the special techniques that have been developed are: the use of heat absorbing elements (such as $CaCO_3$ and carbon) to maintain temperature levels; provisions for efficient use of heat; countercurrent and/or concurrent flow of reactant gases and solids; temperature control; extraneous heat removal or addition as required; use of sweep or inert gases; solid and gas distribution and separation; and elimination of dusting.

We believe that many, if not all, of these and other operations can be shown to be technically feasible. Furthermore, the inherent advantages of the moving-bed process permit designs which in many cases should be more efficient and more economical than alternate solids-gas contacting methods.

Sodium Sulfate

Conversion of Glauber's salt, $Na_2SO_4 \cdot 10H_2O$, to the anhydrous salt cake, Na_2SO_4, has long been an important problem. Numerous methods have been suggested and used to combat the problems that result from the inverted solubility characteristics of the anhydrous material. Use of a moving-bed vertical kiln may have considerable potential for such a process.

Preliminary work has been conducted on the preparation of feed pellets of this material. Recirculation of part of the product may be required. The addition of binders would facilitate feed preparation but may not be required.

A similar approach may be used for other salts that have a negative temperature coefficient of solubility or that have solubility characteristics which are essentially invariant with temperature.

There are additional potential applications for salts with such a high degree of hydration that serious caking problems occur as they pass through a transition or decomposition point to either a lower hydrate or the anhydrous form.

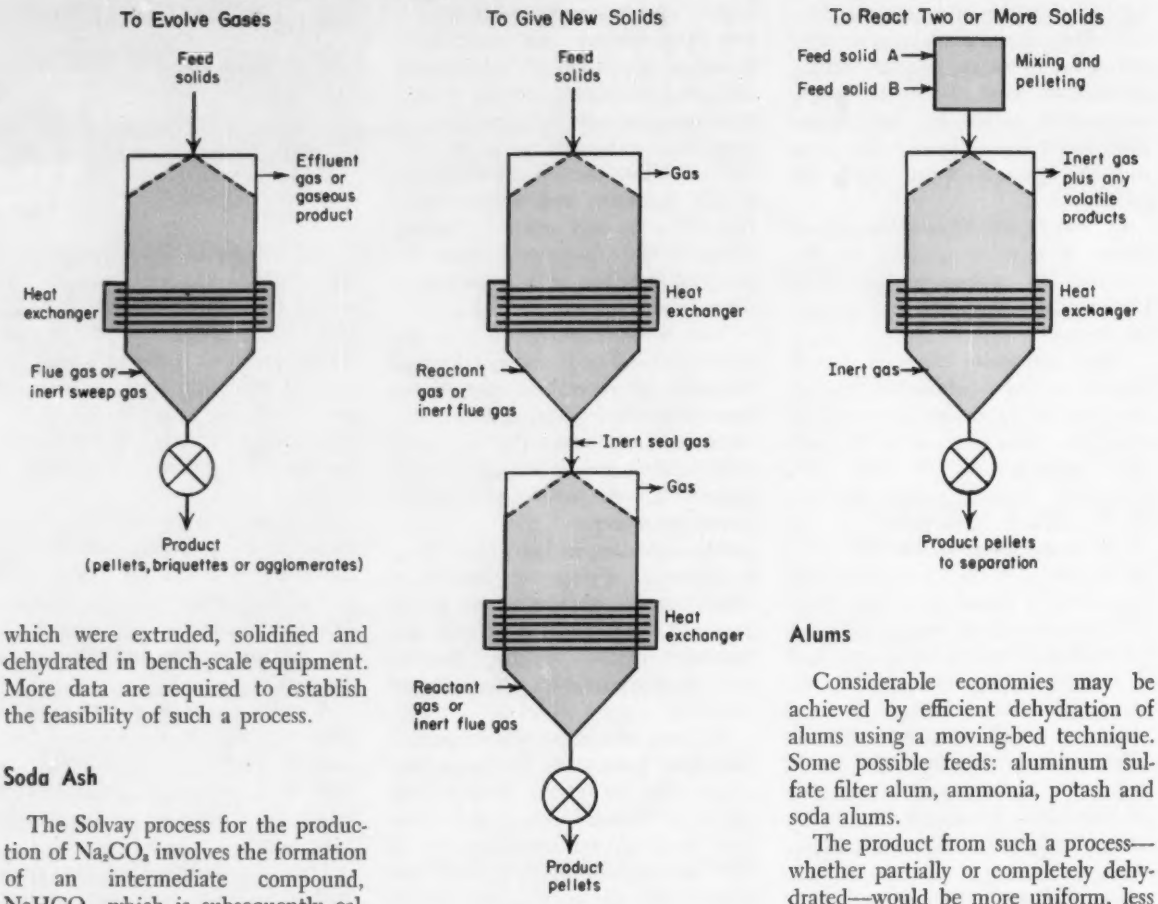
Ammonium Nitrate

Preparation of aggregates of discrete particles of NH_4NO_3 that can be readily treated with caking-resistant coatings has been the subject of considerable work in recent years.

The moving-bed principle may be advantageously incorporated into a process such as a spray operation to minimize the size of equipment and yet provide adequate retention time for complete dehydration. It may even be possible to use it as a complete substitute for the spray or prilling method.

Some preliminary work has been conducted on the processing of molten concentrated solutions of the salt

Solids Composition Changes . . .



which were extruded, solidified and dehydrated in bench-scale equipment. More data are required to establish the feasibility of such a process.

Soda Ash

The Solvay process for the production of Na_2CO_3 involves the formation of an intermediate compound, $NaHCO_3$, which is subsequently calcined to produce Na_2CO_3, water and carbon dioxide.

A large variety of equipment has been designed for calcining the sodium bicarbonate. Moving-bed techniques should lend themselves well to this process which is very similar to the calcination of limestone. The process would facilitate complete recovery of CO_2. Also, it would be particularly suited for markets that require a denser cake.

Clay

Clay is found in many forms. Among the many industries that use clay in some form are: petroleum, paper, rubber, soap and paint.

Many of the techniques now used for the drying and calcining of clay-type materials and volatilization of impurities are relatively inefficient. In many instances where drying or roasting operations are required for the production of this material in suitable shape, form or activity, consideration might well be given to the use of a relatively simple and easily-controlled moving-bed operation.

The preforming of a tremendous variety of clays has been demonstrated by the Houdry Process Corp. using various techniques.

White Lead

Commonly known as white lead, $2PbCO_3 \cdot Pb(OH)_2$, basic lead carbonate is an extremely important commercial pigment.

On the basis of preliminary pelleting studies it is believed that a production scheme for this material can be easily designed to include a simple preforming of the wet basic lead carbonate into a feed suitable for moving-bed dehydration.

Alums

Considerable economies may be achieved by efficient dehydration of alums using a moving-bed technique. Some possible feeds: aluminum sulfate filter alum, ammonia, potash and soda alums.

The product from such a process—whether partially or completely dehydrated—would be more uniform, less difficult to handle and less expensive to produce and transport than the material now obtained by cooling and crystallizing in open pans.

Nickel Sulfate

Preliminary work has been conducted on the preforming and subsequent dehydration of $NiSO_4 \cdot 7H_2O$. Pellets of this hydrate can be formed and dehydrated without binders to prevent disintegration of pellets in the kiln.

This operation and material are considered typical of many similar inorganic salt hydrates. As in the case of many of the other suggested applications, a technically feasible process could be developed using some form of the moving-bed principle.

Other Pigments

It has been demonstrated that

pigments such as TiO_2, lithopone (a mixture of $BaSO_4$ and ZnS), ZnO, $BaSO_4$ and Fe_2O_3 are all amenable to preforming or pelleting. Such materials should be well suited for subsequent drying or roasting in a moving-bed unit.

Insecticides

Insecticides such as lead arsenite, calcium arsenite, and paris green (a copper acetoarsenite) have all been investigated for suitability of preforming or pelleting to permit simple drying.

Moving-bed techniques should also prove advantageous for these applications.

Gypsum

Potential applications for improved moving-bed drying units include the processing of gypsum, $CaSO_4 \cdot 2H_2O$ by controlled heating. This would form either the hemihydrate (plaster of paris) or the anhydrous salt (anhydrite).

Other Decomposition Reactions

The calcination of other materials that contain metal carbonates can also be carried out by moving-bed techniques. As in the decomposition of $CaCO_3$, it is necessary to keep the temperature of the reaction as low as possible to prevent fusion of silicates. This is related to a low partial pressure of CO_2.

A low partial pressure of CO_2 is readily obtained in a moving-bed operation by means of the countercurrent action. In some cases it may be desirable to mix carbon with the charge to lower the partial pressure of CO_2 by reacting with it to form CO.

There are additional fertile fields for application of moving-bed processes for drying or decomposition operations. These include the production of:

- Dolomite lime from either dolomitic limestone or from calcination of synthetic mixtures of magnesite and limestone.
- Magnesia from the calcination of either natural magnesite or from magnesite concentrates.
- Alumina from the dehydration of $Al(OH)_3$, the calcination of bauxite and clay for further chemical treatment and the calcination of plant residues.
- Borax from the decomposition of borates.
- Fuller's earth from the calcination of Fuller's earth clay.
- Refractories from the calcination of refractory clays to minimize shrinkage.
- Phosphates from the calcination of phosphate ores or concentrates.
- Manganese oxides from the decomposition of manganese sulfate, carbonate or hydrated oxides.

The beet sugar, sulfate pulp and water conditioning industries must calcine their byproduct calcium carbonate to lime for reasons of either waste disposal or economy. These operations should be amenable to moving-bed processing techniques.

One of the key advantages that such a process would have over alternate processing schemes is the simplicity of reducing or eliminating dust problems and health hazards. A moving-bed process could avoid the dusting problem in the first place rather than relying on the design of complex and costly dust removal equipment.

Metal Nitrates

In leaching operations in the nonferrous metallurgy field, sulfuric acid is generally a much more economical digestion medium than nitric acid. A major factor in the cost of nitric acid is the absorption of oxides of nitrogen in water.

A suggested processing scheme involving nitrates rather than sulfates consists of an aqueous slurry feed intimately mixed with a gaseous stream of NO and NO_2 to form metal nitrates. The nitrates are then processed by ion exchange, solvent extraction or fractional crystallization to produce a desired purity.

Recovery of fixed-nitrogen values from the various streams can be accomplished by several methods.

Metal nitrate pellets are fed to a moving-bed unit countercurrent to hot gases where they are decomposed to metal oxides. Effluent gases containing NO and NO_2 are recycled to react with additional feed.

Sufficient data are available on each of these steps to indicate that this process is technically feasible for a large variety of materials. Economic feasibility would have to be determined by rigorous evaluations of alternate processes using sulfuric acid.

Zinc Recovery

Recent studies which were reported on the recovery of zinc from sulfide concentrates by chlorination provide another example of an operation that should lend itself well to moving-bed techniques. The operation could take advantage of the excellent temperature control, countercurrent action and solids-handling characteristics that are inherent in such processes.

These bench-scale studies involved the use of air-chlorine mixtures to chlorinate selectively and to volatilize zinc and lead chlorides, leaving behind unchlorinated iron or manganese. The zinc is subsequently separated from the lead.

Metal Sulfides

There has been considerable interest in the volatilization of metal sulfides for the recovery of valuable metals, for elimination of undesired elements and for the separation of various sulfides. It is believed that modern moving-bed techniques are well suited to such operations.

In heating metal sulfides in the absence of air there is a tendency for both decomposition and volatilization, with the characteristics of various sulfides differing very widely. Thus, by using a nonoxidizing atmosphere it is possible:

- To volatilize metal sulfides from nonvolatiles and separate them from each other (Hg, As, Si, Sn, Pb, Cd and Zn).
- To decompose sulfides with partial or complete removal of sulfur as in the case of Ag, Cu, Ni, Co and Mn. (Many sulfides such as those of Th, Hf, Zn, Ba and rare earths are very stable even at elevated temperatures.)

Lime Kilns

As mentioned above, both moving-bed or shaft kilns and rotary furnaces

are used for the production of lime by the calcination of limestone. In some cases the same company uses both types.

The moving-bed unit is basically more efficient with respect to heat economy, flexibility, control, effective solids-gas contacting, true countercurrent flow and high concentration of CO_2.

Fluidized designs, involving multiple beds in an attempt to achieve countercurrent operation, have been proposed but they are inherently more costly, less efficient and more complicated than well-designed moving-bed units.

The major reason for the adoption of rotary calciners for capacities in excess of 100 tons per day has been the difficulty in processing smaller particles and the apparent nonuniformity of the reaction in large cross-section shaft reactors. A rotary kiln designed to process 250 tons per day is rather huge, perhaps 500 ft. long and 12 ft. dia.

In the ammonia-soda industry, modern moving-bed installations have been reported which are far smaller, yet they have capacities of over 300 tons per day. Suitable feed preparation, better distribution of solids and gases and other improvements should circumvent the limitations cited above for shaft kilns.

Blast Furnaces

The modern blast furnace, utilizing the moving-bed principle is widely acclaimed as an efficient shaft apparatus. Predictions have been made that current high rates in excess of 1,500 tons of pig iron per day can be doubled.

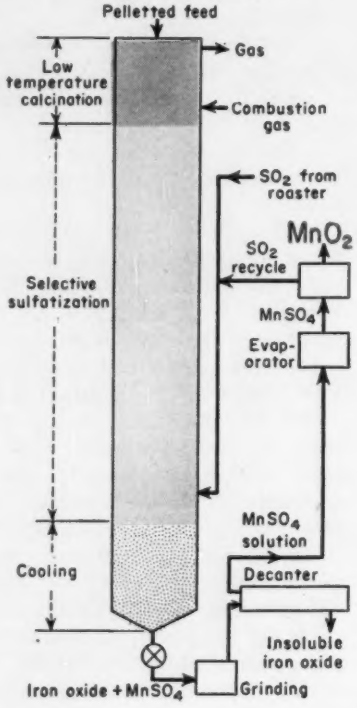
However, there is a growing sentiment to the effect that production rates cannot be economically increased merely by enlarging the size of furnaces. Many challenging papers have been presented questioning the classic type of design, particularly in view of critical changes in anticipated future feeds to these furnaces.

Portland Cement

Portland cement is produced in moving-bed shaft kilns and rotary furnaces, by heating a mixture of limestone and clay (or material of similar composition) to the point of incipient fusion. This is an excellent illustration of the reaction of two or more solids to form new compounds.

Although considerable progress has been made in controlling the operation of shaft units to produce a uniform product of suitable quality, there is room for much improvement. It is possible that the replacement of rotary units by moving-bed shaft kilns can already be justified for smaller installations.

Manganese Recovery From Low-Grade Ores
(U.S. Bureau of Mines)



Manganese

Intensive studies have been conducted in recent years aimed at developing an efficient process for the beneficiation of the large deposits of low-grade manganese ores found in the United States. One of the most promising routes involves feeding ore and pellets of fines to a moving-bed or shaft furnace (see sketch). This process is typical of many that can be developed in the metallurgical field.

The top section of the reactor is a relatively low temperature calcination zone. In this zone CO_2 is removed from the pellets leaving a more porous structure that facilitates permeation of the solids by the sulfatizing gases (mixture of air and SO_2 from roasting of pyrite and pyrrhotite concentrates). The calcination zone is heated by direct contact of the pellets with products of combustion of gas, oil or other fuel. Bottom section of the unit is a cooling zone that leads to a continuous discharge mechanism.

The product is leached to remove $MnSO_4$, evaporated and the salt calcined to form manganese oxide. Another promising possibility would be the final evaporation and calcination of pellets in a moving-bed unit that handles directly nodules or pellets of manganese oxide.

Titanium

For the past several years there has been tremendous interest in the development of new or improved continuous processes for production of both TiO_2 pigment and titanium metal.

Many studies have been conducted and processes patented for the continuous production of the intermediate $TiCl_4$ from ores such as ilmenite using moving-bed shaft reactors.

Briquettes containing mixtures of ore and carbon can be fed continuously by rotary valves into the top of a shaft furnace. In the top section they are preheated. And as they move slowly downward, countercurrent to chlorine gas, the iron content is chlorinated preferentially. $FeCl_2$ passes out with the effluent gas while most of the TiO_2 is present in the solid removed at the bottom.

Variations of this method involve adjusting conditions to provide complete chlorination of both the iron and titanium, with removal, condensation and subsequent separation of the iron and titanium chlorides.

Binders such as molasses, tar, asphalt, sodium silicate and hydrated TiO_2 have been suggested for briquetting. Subsequent baking volatilizes hydrocarbons and water.

For heat control and to circumvent some of the problems of contamination at elevated temperatures, various

techniques have been patented. They include: preheating of the furnace to permit the exothermic reaction to proceed without additional heat input; addition of titanium carbide or cyanonitride to absorb enough heat to maintain the desired temperature; and internal heat generation from the heat of reaction resulting from the chlorination of Si, Fe, Al, etc., which are fed to the reactor with the TiO_2 and carbon.

The addition to the briquettes of carbon in the form of coal or coke has also been suggested for better temperature control.

Interest has also been shown in the possible use of moving-bed techniques for continuous reduction to titanium metal.

Other Metals

Reduction roasting of iron oxide ores or concentrates in contact with a reducing gas can be conducted in a moving-bed apparatus in which pellets of iron oxide are reduced to sponge iron at temperatures controlled well below the melting point of the iron.

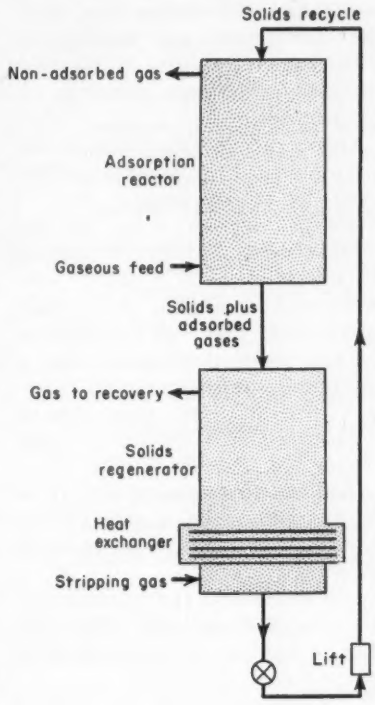
The sponge contains metallic iron plus silica and gangue minerals.

Reduction of many other metal oxides, such as CuO, NiO and WO_3, can also be conducted in similar fashion, with the temperatures controlled sufficiently below the melting point of the metal or other primary constituents. This allows the removal of product as discrete pellets or briquettes.

As discussed for titanium, iron, copper, zinc and manganese, the moving-bed principle should find many new and broad applications in nonferrous metallurgical fields, in the preparation of intermediates as well as in subsequent reduction to metal. Some of these applications studied by the Catalytic Construction Co. have indicated truly remarkable potentials.

The possibilities of such continuous reduction methods are even further enhanced when these processes are carefully integrated with new developments for converting dispersed metal powder to massive form by: vacuum, inert atmosphere and other melting or sintering techniques; and by powder metallurgy.

Solids Composition Remains Unchanged-Adsorption



SO_2 from Sulfides

There have been many recent publications related to studies on: new or improved techniques for the recovery of SO_2 for acid manufacture; and/or the conversion of ores or concentrates to forms suitable for recovery of valuable metals.

In general, the primary reason for roasting pyrite ores is to obtain SO_2 for the production of sulfuric acid. The general mechanisms are similar whether pyrite is being calcined for metal recovery or roasted for SO_2 and sulfuric acid production.

For SO_2 recovery the amount of sulfur in the feed and the requirements for SO_2 concentration in the gaseous effluent are much higher than for metal recovery.

In zinc roasting the objectives are to produce a calcine for either electrolytic or retort zinc. Recovery of SO_2 for acid manufacture is usually an auxiliary operation. Copper concentrate roasting is directed either at partial reduction of the sulfur content to correspond to the desired sulfur analysis in a smelter or at sulfatizing the copper to render most of it soluble in water or weak acid.

Fluidized bed and other techniques have been proposed for the roasting of arseno-pyrite gold ores to render them more amenable to cyanidation. The ore concentrates may contain antimony, telluride, sulfur, arsenic and other elements.

In order to free the gold it is necessary to oxidize and volatilize the arsenic and sulfur. Factors of major concern are the minimizing of subsequent cyanide consumption while maintaining high gold recovery.

The reactions involved are similar to others that have been successfully conducted using moving-bed methods.

Solid Composition Remains Unchanged

The outstanding application of the moving-bed principle to reactions where the solid is either unchanged or regenerated is the catalytic cracking of petroleum hydrocarbons. Aside from this, new moving-bed applications—while interesting and noteworthy—do not appear to have the potential of the categories discussed above that involve permanent change in solid composition.

The following discussion presents several typical examples of:

- Adsorption.
- Chemical regeneration of solids.
- Heat transfer.
- Nonpetroleum heterogeneous catalytic reactions.

Adsorption

The development of new solids-gas contacting techniques has broadened the application of adsorption not only for separations that are uniquely suited to it, but also for many uses that were previously considered uneconomical.

Moving-bed techniques have an important potential for two groups of adsorption processes:

- Regeneration by heating with hot gases of clays or other adsorbents used in the treatment of liquids.
- Gas-phase adsorption and de-

sorption for operations such as solvent recovery and gas purification, separation or dehydration.

The process of hypersorption has been extended to methane purification and the recovery of ethylene. Future similar applications may include; purification of hydrogen; synthesis gas treatment; propane and butane recovery; removal of nitrogen and sulfur from natural gas; nitrogen purification; recovery of ethylene from cracked gases; acetylene recovery from oxidation gases; and various petrochemical fractionations such as the separation of methane from HCl and other hydrocarbons.

In addition to these there are many industrial operations involving adsorption in the chemical and metallurgical as well as the petroleum industries which should lend themselves to the use of moving-bed processes.

Among the industries where solvent recovery is important are: plastic coatings of paper and cloth; rubber products; cellulose acetate rayon; and smokeless powder. Continuous adsorption processes can be designed for the recovery of practically all industrial solvents such as hydrocarbons, esters, ethers, ketones, halogenated compounds and alcohols. At present, practically all of these together with others cited below are operated as cyclic batch adsorption and desorption processes.

Instances of gas purification are the removal of odors and other impurities in air conditioning systems and the adsorption of contaminants from industrial gases such as ammonia, compressed air, hydrogen chloride, hydrogen fluoride, carbon dioxide, hydrogen and nitrogen. An important process for the possible application of moving-bed techniques is the dehydration of air or process gases.

Regeneration of Reactant

A report on a pilot-scale moving-bed operation was recently presented where solid pellets fed to a pilot-scale unit were chemically changed and subsequently regenerated into the original chemical state.

The process involved impregnation of inert particles with zinc oxide. The particles then react with ammonium sulfate in a reaction zone where SO_3 combines with ZnO to produce $ZnSO_4$. This releases gaseous water and ammonia. These gases were removed from the reaction zone while the inert solids (now impregnated with zinc sulfate) were decomposed thermally in the lower reactor to regenerate zinc oxide.

Oxides of sulfur were evolved and the regenerated zinc oxide recirculates to the top of the reactor.

Similar processes would be: the manufacture of hydrogen by reacting FeO with steam in a reactor with subsequent regeneration of the Fe_3O_4 in a separate unit, and the return of FeO to the reactor; and the use of metal oxides as oxygen carriers to prepare pure SO_2 and carbon oxides without the need for nitrogen separation.

Additional examples of applications to the regeneration of solids, which have been suggested or patented, can be cited:

- Reaction of methane with iron to form Fe_3C and H_2. The solid Fe_3C is converted to iron by burnout of carbon and recirculates.
- Reaction of Fe and H_2O to form H_2, Fe_3O_4 and FeO. Regeneration of solids would be conducted by reducing iron oxide to iron.
- Numerous variations of the above general schemes for producing H_2 have been patented using various types of contractors. For many commercial operations it appears likely that fixed-bed units will be supplanted by continuous solids-recirculation methods.
- The oxidation of ammonia to hydrazine hydrate using a moving bed of reducible metal oxides. The oxides are re-oxidized in a second chamber and recycled to the first reactor.
- Separation of CO or oxygen from gas streams by passing them over solid compounds such as calcium manganite, calcium plumbate and manganese oxide, with subsequent regeneration of solids and release of gases.
- Fluorination of hydrocarbons with moving-bed of CoF_3, with regeneration and recirculation of solids.

Heat Transfer

We have described the Thermofor Pyrolytic cracking process on p. 179. An application of the pebble heater originally developed for superheating steam, TPC is also used to preheat air for combustion and various chemical operations.

Additional possibilities that have been proposed for commercial applications are:

- Heating of gases such as hydrogen and natural gas for the reduction of metallic oxides.
- Production of high combustion temperatures in the field of refractories for continuous melting processes for the production of prefused grog in making brick and motar.
- Manufacture of fused cast refractories from materials that have been melted in a high-temperature combustion furnace.
- Production of refractory mineral fibers by blowing a molten refractory stream with high-pressure steam or air.
- Direct firing of ceramic ware.

Patents have been issued on the use of pebble heaters for: vaporization of sulfur; removal of condensables from air at low temperatures; evaporation of black liquor in the paper industry with subsequent combustion of residue; desulfurization of hydrocarbons; the manufacture of CS_2 from carbon and sulfur heated by pebbles; and the production of ethylene and fuel gas by pyrolytic cracking of hydrocarbons.

The future should bring many new developments that incorporate this heat transfer concept in chemical and metallurgical operations. As in most cases of moving-bed applications, these units should be designed with full cognizance of such factors as capacity, properties of the materials involved, location and specific operational problems.

Catalytic Reactions

As a rule, most heterogeneous catalytic reactions that involve gas-phase conversions catalyzed by solids are conducted by fixed-bed methods.

In high-temperature organic reactions activated by solid catalysts, the conversion gradually declines due to catalyst fouling or deactivation. Where the catalyst can be used for only short periods without reprocessing or renewal and the heat effects

are appreciable, a continuous moving-bed technique may have potential value for supplanting fixed-bed operations.

Particular attention should be directed at the selection of sound and practical processing schemes before estimating costs. Many processes can be ruled out after a very preliminary study. Conversely, some moving-bed applications which appear uneconomical may be based on arbitrary and unsound assumptions.

To approximate optimum conditions in a heterogeneous catalytic reaction, the control of temperature is often the most critical single problem in reactor design. Experience on a number of fundamentally different approaches is available:

- Use fixed-bed adiabatic reactors with intermediate heat exchangers.
- Add an inert constituent with high heat capacity to the reacting gas stream.
- Mix inert solids that have high heat capacity with the catalyst to form pellets.
- Inject reactants and diluents at various points along the reactor.
- Remove heat by close contact of solids with heat transfer elements.
- Integrate closely the reaction and regeneration to store and subsequently release the heat in short, cyclic operations.
- Move the catalyst by moving-bed or fluidized-solids methods.

Many reactions have been investigated or patented and representative examples of these are listed below. The application of the moving-bed principle to most—if not all—of these should prove technically feasible.

- Steam reforming of methane for the production of synthesis gas.
- Oxidation of naphthalene to phthalic anhydride.
- Oxidation of benzene, butenes or butadienes to maleic acid.
- Ethylene oxide from air and ethylene.
- HCN from the catalytic cracking of formamide vapor.
- Vapor-phase nitration of aromatics and paraffinic hydrocarbons.
- Production of unsaturated aliphatic aldehydes by vapor-phase catalytic reactions to formaldehyde and saturated aliphatic aldehydes.
- Reduction of nitro compounds to amines.
- Oxidation of SO_2 to SO_3.
- Reduction of sulfur dioxide to sulfur.
- Production of phosgene from CO and Cl_2.
- Reaction of SO_2 with hydrocarbons to form thiophene.
- Polymerization of olefins.

It would be meaningless to discuss economic merits of these examples without comprehensive comparisons of alternate methods.

19 Unique Advantages of the Moving-Bed Technique

1. Simple provisions for concurrent or countercurrent flow with moving-bed units, easily permitting large number of stages. These can not be obtained in fluidized bed without excessive investment and complications of equipment design.
2. Versatility for handling a wide variety of solids.
3. Little or no problems of dust entrainment in effluent gas stream. This is a particularly serious problem with fluidized beds, involving complex and costly dust recovery equipment.
4. Reasonable pressure drops across the beds.
5. Simple provisions for establishing temperature gradients along the reactor to permit optimum conversions. This is very difficult if not impossible to obtain with fluidized solids except by use of reactors in series.
6. Ease of start-up and shut-down of operations.
7. Suitability for handling valuable or hazardous materials.
8. Provision for a wide range of retention time of solids in reactor.
9. Uniformity in residence time of catalyst.
10. Negligible erosion.
11. Readily adapted for elevated pressures.
12. Avoid problem of short-circuiting of feed to solids exit line.
13. Ease of feed preparation and simplicity of operation.
14. Large contact times attainable.
15. Simple solids recirculation.
16. Minimized attrition of solids.
17. Avoidance of excessive homogeneous phase reactions caused by high void fractions.
18. Flexibility of solid and gas flow rates and capacities.
19. Suitable temperature control by various heat transfer techniques.

Many Advantages

The moving-bed technique has many unique advantages over alternate methods, such as fluidized-solids, for chemical and metallurgical applications in particular. Many of these advantages apply equally well to the reactions of gases catalyzed by solids. The table above lists some of these advantages.

Solids-Liquid Applications

Although the emphasis in this report—and by far the greatest potential—is the contacting of solids and gases, it is interesting to note recent developments in the application of the moving-bed principle to two solids-liquid operations: ion exchange and adsorption.

Unlike solids-gas contactors, where there is a very large density difference between the two phases, in solids-liquid systems the density difference is small. Solid flow rates that would be obtained by gravity flow are relatively slow.

Until recently, installations involving the use of ion exchange resins for

water softening, demineralization and separation of ions were accomplished either by single-step batch or by fixed-bed operations. In the first, a batch of resin is equilibrated with a definite volume of solution. The fixed-bed scheme involves flow of solution to be treated through a stationary porous column of ion exchange resin. Periodic elution regenerates the column.

The obvious drawbacks of such cyclic operations and the advantages of continuous, countercurrent, steady-state methods for the separation of ions were the bases for investigations of new ion exchange processes over the past five years by the Atomic Energy Commission and other organizations.

Favorable progress has been reported on the development of several types of moving-bed processes with countercurrent flow of resin and liquid. Among the major obstacles to the development of these processes are the limitations of liquid throughput, solution densities and operational flexibility.

Two continuous countercurrent processes that use variations of the moving-bed technique were reported recently. In the Higgins contactor, solution flows downward through a packed bed of resin. Periodic interruption of the flow of solution moves the resin bed upward hydraulically in slug flow.

In the second process, a rotating cylinder is incorporated in a so-called spinner column designed to minimize channeling and thus provide better efficiencies.

There is considerable interest at present in several modifications of these continuous countercurrent moving-bed methods for many important commercial applications.

Until recently, studies of ion exchange were almost exclusively centered about the development of suitable cation and anion exchange resins. Commercial processes were in most cases scaled-up batch-type installations.

Increasing effort being exerted on the development of continuous units instead of alternating fixed beds will undoubtedly lead to the development of many new and valuable industrial applications. The suitability of such techniques for new or improved applications should be based on objective evaluations of units specifically designed for a given problem. Standard equipment is not yet available.

The moving-bed principle is an ideal basis for the design of truly continuous countercurrent solids-liquid contactors. Many modifications have been suggested and others will undoubtedly be proposed in the future. It has been the experience of the Catalytic Construction Co. that many of the basic principles involved in solids-gas and liquid-gas contacting processes can be applied to such designs.

This includes solids flow control, distribution and level measurement, stripping techniques, seal legs, solids-liquid engagers and disengagers, solids recirculation and the use of reflux to enhance separation. In the future the production of many resins will undoubtedly be guided by the requirements for use in moving-bed equipment.

Among the most important applications of the moving-bed principle to adsorption using solids-liquid contacting is the Thermofor continuous percolation process. Thermofor continuous percolation was originally developed for decolorizing lubricating oils and waxes.

The process involves oil decolorizing and clay washing with continuous countercurrent flow of the liquid and granular solids. This has been integrated in commercial units with operations for drying and regenerating clay in Thermofor clay burning furnaces.

Many industrial operations are presently conducted by fixed-bed or batch adsorption techniques. These include: refining of vegetable and animal oils, fats and waxes; water treatment; recovery of precious metals; solvent recovery; cane sugar refining; decolorizing and purification of inorganic and organic materials; elimination of industrial odors; dehydration and purification of air and industrial gases; treatment of industrial wastes; and glucose production.

Many of these operations could be advantageously conducted by moving-bed techniques with continuous regeneration of the solids. The size of such equipment can be designed and instrumented for a broad range of capacities.

There have been many other suggestions and studies on the use of moving-bed methods for solids-liquid contacting operations in extraction, leaching and catalysis. However, there are no available experimental or cost data to show the relative economic merits of such applications, particularly in comparison with new or improved extraction and leaching techniques.

There has also been considerable interest in using moving beds of limestone for treating acid wastes.

Prognosis

Many of the moving-bed applications cited above—in addition to numerous others not discussed—are being studied and applied by the Catalytic Construction Co. and the Houdry Process Corp.

In general, while there will probably be many future applications in heterogeneous catalysis, the greatest potential for new applications of the moving-bed principle appears to be in the area of noncatalytic reactions in the chemical and particularly the metallurgical field.

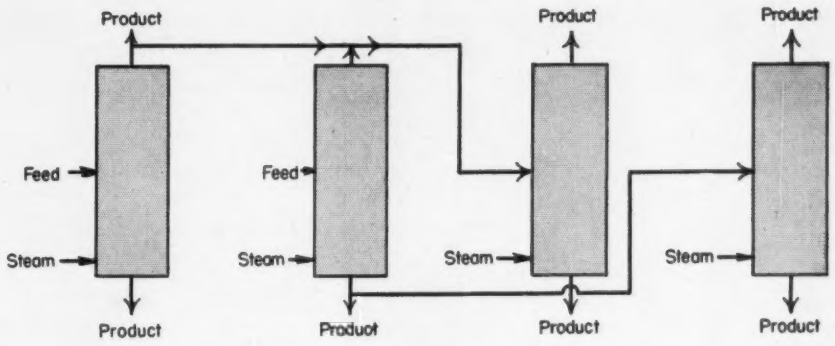
For Your Files . . .

Reprints of this 32-page report on Moving-Bed Processes are available at 75¢. You will also want a copy of our May Report—Solids-Gas Contacting—which supplies an integrated background for the theory and applications of moving beds. Use your Reader Service postcards for fastest service.

Solids-Gas Contacting, 10 p., Reprint No. 63, 50¢

Moving-Bed Processes, 32 p., Reprint No. 64, 75¢

PROBLEM: Prediction of steam consumption for cost control



Month	Total Charge, Bbl.	Steam, 1,000 Lb.	Lb. Steam per Bbl. Chg.	Actual as % of Avg.
Jan.	1,005,900	69,650	69.2	125
Feb.	1,198,900	60,180	50.2	91
Mar.	1,064,100	64,640	60.8	110
Apr.	1,081,200	45,750	44.2	80
May	1,077,400	43,900	40.8	74
Jun.	1,253,800	72,690	58.0	105
Jul.	688,800	54,480	79.2	143
Aug.	1,129,300	67,310	60.0	109
Sep.	1,066,200	82,530	77.4	140
Oct.	1,211,000	63,510	52.4	95
Nov.	1,384,100	39,650	21.4	39
Dec.	1,203,100	58,360	48.5	88
Avg.	1,113,800	60,220	55.2	100

SOLUTIONS:

Historical Method—Variable data give poor results

Engineering Approach—Better predictions by these methods

Engineering Your Cost Reduction

Engineers can apply their knowledge to come up with vastly better standards. Hidden cost reduction opportunities come to light, and control is tightened.

D. V. BIERWERT and F. A. KRONE, Monsanto Chemical Co.

Are your profits and costs going in the wrong directions? What can be done about it?

These questions are provoking a great deal of management thinking today for current predictions are that the chemical industry will be faced with a period of considerable readjustment during the next few years.

Increased competition will demand initiation of programs for improved operational performance and efficiency. As these programs progress, measurement of present and potential performance levels will become increasingly critical, and in some cases, may make the difference between survival and extinction. Engineers can make important contributions to these measurements.

Standard cost systems in one form or another are becoming widely used as a means of gauging performance levels. Most systems in use today rely heavily on historical data developed in the "fat" years, and as a result, have a somewhat limited application to future conditions.

There are three major types of standards classified by major field of

From COST SHEETS come . . .

Trizon A (Production, 8,000,000 lb.)

Item	$/Month	$/100 Lb. Product
Raw material	320,000	4.000
Direct costs, total	61,520	0.769
Steam	40,000	0.500
Power	8,000	0.100
Water	320	0.004
Labor	4,000	0.050
Supt.	800	0.010
Soc. sec., ins., etc.	240	0.003
Repairs	2,400	0.030
Catalyst	5,600	0.070
Others	160	0.002
Indirect costs, total	5,600	0.070
Depreciation	3,200	0.040
Overhead	2,400	0.030
Total Cost	387,120	4.839

COST STANDARDS and . . .

Cost Standards — Trizon A

Item	Budget Standard	Production Control Standard	Cost Reduction Standard
Raw material, lb. oil/100 lb. prod.	49.3	47.61	...
Steam, M lb./100 lb. prod.	0.47	0.40	0.22
Power, kwh./100 lb. prod.	9.75	9.75	...
Water, cu. ft./100 lb. prod.	6	6	...
Labor, manhours/mo.	2,400	2,400	...
Supt., $/mo.	800	0.009*	...
Ins., taxes, etc., $/mo.	200	AAS†	...
Repairs, % of mach. & equipt./yr.	8	8	...
Catalyst, lb./100 lb. prod.	0.017	0.014	0.010
Others, $/mo.	145	145	...
Depreciation	AAS†	AAS†	...
Overhead, $/mo.	1,900	AAS†	...

*Dollars per 100 lb. of product. †Actual as standard.

application: (1) budget standards, (2) production control standards, and (3) cost reduction standards.

Budget Standard

Most commonly used standard is the one based on past history, which we will call the budget standard since it is most applicable in this field. Budgets generally are set up to predict what is most likely to happen. Historical mathematical averages can and have been used widely. However, statistical averages may provide a truer basis for the prediction of your costs.

If the cost variations are due to factors having normal probability, the historical mathematical average usually will be satisfactory as a budget standard. If, however, unusual variations occur, a statistical analysis should be made and the standard established within appropriate confidence limits. A screening of the historical data used in the development of the budget standard is therefore essential.

Budget type standards are often applied as yardsticks to production departments. Main difficulty with this approach is that present performance is judged on past performance rather than on the basis of process capabilities. The production control standard described below eliminates this difficulty through the engineering approach.

Production Control Standard

The production control standard should be based on process capabilities determined by engineering study and experimentation. For example, in a labor-controlled operation, past history

Cost Standards and . . .

Budget Standard

Based on past history. Determined by mathematical and statistical averages.

Production Control Standard

Based on existing process capabilities. Determined by engineering studies.

Cost Reduction Standard

Based on process capabilities adjusted for improvements resulting from pending capital expenditures. Determined by engineering studies.

What They Can Do for You

Use made of standards for control purposes will vary with the several members of the management group.

By using the soundly-developed budget standard, the **sales manager** can determine what profit margin he can expect when he establishes selling prices for his various products. Current operating reports compared with the budget standard will show trends which may be used in price revisions.

The **production manager** will have a keen interest in all three standards. Current operations can be evaluated against the historical reference of the budget standard, and against the process capabilities of the production control standard. Explanations of variations from the production control standard will have increased significance since the standard will have been carefully evaluated with all basic premises clearly defined. The cost reduction report will indicate to the **production manager** the status of individual projects, their progress and dollar return, and will to some degree measure the effectiveness of the **technical development group.**

Operating line supervision, through the production control standard and production control report, can measure their current departmental performance against process capabilities established by the standard.

Current progress of the **technical development group** can be measured against the schedules established in the cost reduction standards.

COST REDUCTION PROJECTS evolve from standards

Cost Reduction Status Report

Project Description	Date Started	Goal Date	Mo. Savings Goal	Savings to Date	Project Cost to Date	Capital Req'd.	Status Capital Request	Control Index Orig.	Control Index Goal	Control Index Diff.	Control Index Attained	Comments
Solvent Recovery - Yield Basis	6/54	3/55	10,000	0	2547	8670	Prep.	85%	90%	5%	85%	Trial Runs
Steam Reduction - usage per 100# Prod	7/54	2/55	25,920	60,000	16,000	15,000	App'd	0.42	0.22	0.18	0.25	Final revs.
Reduce Catalyst Consumption	10/54	6/55	1320	0	1580	3000	App'd	0.014	0.010	0.004	0.014	Equipment
Increase filtration rates for base liquor clarification	9/54	11/54	3700	5000	4200	2400	App'd	250 GPM	400	150	325	process rev. will comple

may show that thirty items per hour were handled. But through study and experimentation it was evident that forty items per hour could be handled with no change in existing conditions or equipment. It is obvious that for production control purposes, the control standard should be established based on the forty item per hour rate.

Cost Reduction Standard

Quite often the engineering studies used to determine production control standards will lead to information which can be used to assess cost reduction potentials. Equipment or process changes may be involved. Quantification of the evaluated data may lead to a cost reduction standard.

For example, in the determination of the steam and fuel consumption standard for a distillation process, we may learn that the unit is operating at poor thermal efficiency, and that by the incorporation of heat exchangers or changes in flow, sizable steam and fuel savings can be had. The cost reduction standard in this case would be the production control standard minus the potential savings evaluated for steam or fuel.

With the cost reduction standard available, management has a basis for justifying the costs of required equipment or process revisions. The basis would be the difference between the production control standard and the cost reduction standard.

Engineering Approach

The engineering approach and its value may be illustrated by the following example, which involves multiple unit operations with a single measurement of utilities for the complete battery.

In a petroleum refinery or petrochemical operation, a single battery of stills is often used to prepare a variety of products from feed stocks which vary only slightly from day to day. Such case is shown at the top of p. 207.

Products require operation of the columns at various reflux ratios, under conditions which require splits from 40% to 80% of the charge taken off as bottoms. Steam consumptions and charge rates are shown in the table along with steam consumption per barrel of charge.

As shown in the last column, use of average steam consumption per barrel of charge would obviously lead to a great error in prediction of steam consumption from charge data. Better correlation between actual and predicted steam could be gained by using a figure based on total charge to all four stills. However, in this case, major variables like the split between bottoms and overhead and the reflux ratio are neglected, so that correlation between actual and calculated values is poor.

Best practical approach to the problem of calculating a steam standard in this case involves the correlation and reconciliation of all variables with historical consumptions.

A typical formula derived in this way is:

$$S_t = FS_f + RS_r + Pa + Qb$$

Where: S_t = total steam for one still
F = feed charged per month
S_f = average steam consumption/unit of feed for a given percent bottoms and feed (calculated by theoretical heat balance)
R = Reflux quantities per month
S_r = Average steam consumption/unit of reflux
P = Material pumped by steam pumps per month
a = Pounds steam required/unit pumped (derived by calculations plus tests)
Q = Operating hours per month
b = Fixed steam per hour

The above approach appears formidable at first glance, but usually certain assumptions such as constant overhead or bottoms temperature can be made without seriously affecting the utility of the standard for budget or overall control purposes.

Analysis of the rates of consumption for the separate units provides a truer basis for budgeting or control since it results in predictions within 10% of actual values. As shown in the table, only five out of twelve predictions from the historical average were within this range of accuracy. Both management and line supervision stand to gain when production is measured against a standard based on sound engineering evaluations.

How It Works

The engineering approach is not applicable to all standardizable items. There are many cases where high cost of studies or lack of measurement require the use of historical averages in arriving at standards.

The following example shows the problems and typical solutions involved in standardizing a large scale chemical operation. Product names and data have been changed.

The technical development group was asked to study an operation which had been in existence for some time. A typical cost sheet for this department is shown (see Trizon A cost sheet).

The twelve major cost items were first studied by reviewing and analyzing variations from average input usages per 100 lb. product over an extended period. Where unusually rare and extreme variations were evident, a statistical analysis was made and 95% confidence limits were established. When such unusual variations were not evident, the arithmetic average was used as the budget standard.

Of the standards that were developed, major cost items (steam, electricity, labor and catalyst) were selected for a more detailed investigation.

For steam, basic heat balances were recalculated using the research and operating data available. Experimental control runs were made to measure heat losses at various points in the process to check and expand both current operational and analytical data. Optimum steam efficiency attainable with the current equipment and process was then calculated to establish the production control standard for this item.

In the course of the studies, potential reductions in steam use appeared possible. Excessive steam use was due in part to faulty steam traps, inefficient and poor control of steam ejectors, and not shutting off steam between distillation runs. Reactor product outlet heat was not utilized in any subsequent steps, and the quality of the product was higher than market demand. Preliminary evaluation of product return through a heat exchanger appeared economically attractive, and test runs indicated that a lower reflux ratio on the product still would be permissible.

Steam savings of 0.07 M lb./100 lb. product, which could be realized through proper operation and repair of traps, were reflected in the production control standard. Additional savings through installation of the heat exchanger and lowering of reflux ratio were estimated to be 0.18 M lb./100 lb. product or $25,320 per month, so that the cost reduction standard was set 0.18 M lb. lower than the control standard.

Power, due to the complexity and number of power units involved, was left as the arithmetical average. Labor was derived from an analysis of the organization chart.

Catalyst consumption was found to be high due to operators' lack of attention to feed equipment. On the basis of test runs, it was found that catalyst consumption could be reduced 28%. Additional studies based on original laboratory analyses indicated that installation of automatic control instruments would give the cost reduction standard shown.

Personnel and Reports

Responsibility for determination and preparation of the standards should be that of the technical development group. This group gathers, correlates, and analyzes the basic data needed for evaluating departmental performance. Before the results of these evaluations can serve as standards, they must be justified to and be accepted by the respective operating departments concerned. In this sense, the concerned department has a joint responsibility with the technical development group in the preparation of an acceptable and sound standard.

Data used to establish the standards as furnished the accounting department will be operating data (performance data expressed in applicable measured terms such as pounds, manhours, gallons, kwh., etc.). Then for cost reports, the basic data will be extended to dollars by the accounting department. For performance reports, the operating data need only be converted to a unit basis and extended for consumption and variation totals by the accounting department.

The budget report should include the budget standard and current operations expressed in unit and total usages, plus costs and variances for the current month and year to date.

The production control report should include the production control standard and current operations expressed in units and totals for usages and variances, and total dollar variances by cost item.

The cost reduction report should list a summary of the cost reduction projects. This report would be issued quarterly or semi-annually by the accounting department.



DONALD V. BIERWERT is manager of production control for Monsanto's plastics division. He joined Monsanto in 1943 as a research chemist, then served two years in the navy as a Lieutenant J. G. He is a chemical engineering graduate of Princeton University, and is a member of A.I.Ch.E. and A.C.S.



FREDERICK A. KRONE is operations supervisor of polyethylene production for Monsanto's plastic division at Texas City, Tex. He joined Monsanto in 1951 as a planning engineer for the plastics division. He is a 1942 chemical engineering graduate of Lehigh University, and is a member of A.I.Ch.E. and A.C.S.

HOW TO SELECT

Plant Drives for Process Heat Balance

In using steam-driven plant drives as sources of process steam, very careful selection is necessary to insure over-all economy.

THOMAS H. ANDERSON, Jr., C. F. Braun & Co.

In the past, when fuel costs were less a problem in process plants than they are today, the selection of drives for heavy plant equipment, such as the large pumps and compressors, was much easier than it now is. However, analysis of steam consumption in process plants has brought out some basic rules. To use steam efficiently, the actual pounds generated must not be more than the sum of the pounds of steam required for heating in coils and jackets (closed steam), plus the pounds used as open steam. No steam must be allowed to exhaust to the air. And condensing drives must not be used unless the heat of condensation can be recovered usefully—or there are other overriding reasons. So, the selection of plant drives becomes an economic problem in deciding to what extent these drives should be motorized or, on the other hand, steam driven; and to what extent the plant should endeavor to generate its own electric power.

The first step, of course, is to select a process design to compute the heat and material balances, as well as the heat loads and their temperature levels. At this point we have to answer the question: What is going to supply this heat? Fortunately, there are some rules of thumb which help to make the answer easy.

Steam is the best source of process heat up to 400-450°F. This limit comes from the fact that it takes 600 psig. steam to approach 450°F. out of a reboiler or heater. There are, of course, higher temperature heat media of both the liquid and the vaporizing types including oils, Dowtherm, fused salts and certain low-melting alloys. These can be used for temperatures well above the practical top for steam. Direct firing can also be used in this range and above. However, these are all outside the scope of this article.

To start, the engineer should add 40-50 deg. F. to his maximum process temperature. This will give him the temperature of the heat medium. In the case of steam he can convert this temperature to pressure. If the control valve is to throttle the steam, 15-20 psig. should be added for control. It may also be desirable to add more pressure drop for flexibility. The total will then give the necessary steam pressure. However, if the engineer is close on pressure, he can decide to throttle the condensate and thus decrease the necessary pressure drop.

When the process temperature is 400-450°F., the steam pressure will be 400-600 psig., which is a good limit because higher pressures require special piping and heat-transfer equipment. It is true that central generating stations use steam at 1,000 psig. and higher, but in most process plants you cannot extrapolate power plant practice, unless there are special conditions such as need for large generating capacity. The cost of special equipment, as well as the hazards of both high pressure and high temperature, usually make steam unattractive in the process plant power house at pressures over 600 psig.

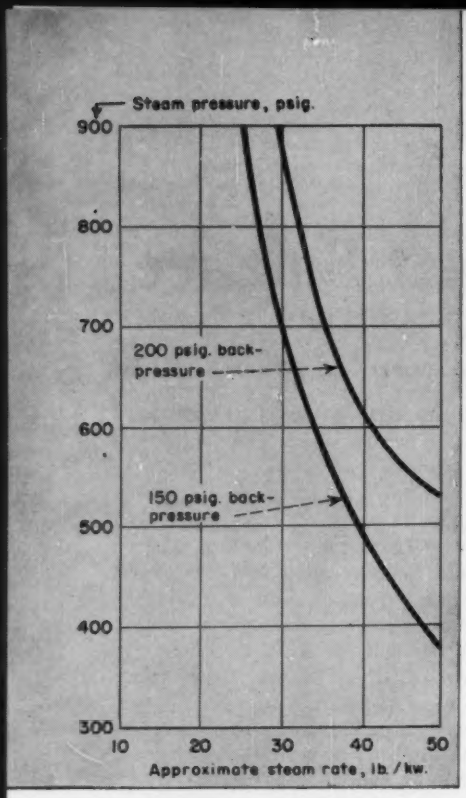


T. H. ANDERSON, JR., graduated in chemical engineering in 1932 at MIT, taking his MS there in 1933. Until 1947, when he joined C. F. Braun & Co. at Alhambra, Calif., he was first with Standard Oil of Louisiana, later with Standard Oil of California, in process work, maintenance and construction. Presently senior project engineer with Braun, he has been project manager recently on a number of large petroleum industry expansions.

Having discovered in this way which of our temperature levels can be supplied by steam, our next step is to tabulate also the open steam requirements of the process. As in the case of closed steam for jackets and coils, we should add 15-20 psig. to the process pressure for control. Finally, the sum of the open steam, plus the closed steam requirements, gives us our necessary boiler capacity. The highest pressure required has become the minimum boiler pressure. From this point on the problem is a jigsaw puzzle to determine the least number of steam systems we can use, and at the same time extract the most work from the steam. Obviously both conditions cannot be obtained at the same time, and our answer must be a compromise. At this point we must never forget flexibility. We must provide sufficient alternate drives to permit swings in operation and, at the same time, never exhaust any steam to the air.

Drives Available

Reciprocating steam pumps are the old standbys of the process industries. They can be used for low to moderate capacities, and medium to high heads.



Approximate steam rate for turbo-generators exhausting at 150 and 200 psig.

However, don't try to use them for large-capacity, low-head services. It is important to remember that these pumps operate by pressure differential only. This means that a pump which requires 100 psi. differential will run just as well with 250 psig. inlet and 150 psig. exhaust as it will with 100 psig. inlet and atmospheric exhaust. These are our most reliable pumps. They are the obvious answer for low capacity 50 to 150 psig. exhaust systems.

On the other hand, styles change and centrifugal pumps are the mode today. They fit nearly every service with the possible exception of low-capacity, high-head service. They operate without the pulsation of reciprocating pumps, and they also give a choice of drive: mechanical-drive steam turbines, motors, and internal combustion engines. The first of these may well be your choice if you want to reduce boiler pressure to process utilization level.

Up to 200-300 hp., mechanical-drive turbines operate well on 100-250 psig. steam. As the back pressure increases, so does the steam rate increase. It jumps when the back pressure gets over 40-50 psig. Steam pressures over 250 psig. do not show sufficient improvement in steam rate to warrant the special design required. Therefore, it is a good rule in using mechanical-drive turbines to hold the steam pressure down to 100-250 psig., and the back pressure between atmospheric and 50 psig. However, you must always keep over 100 psi. differential across the turbine.

When the brake-horsepower of the pump goes over 200, these general rules no longer hold. With these higher power requirements the turbine can be large and can easily be designed for higher pressures and temperatures. If the engineer is looking for a service to reduce 400 or 600 psig. steam to around 150 psig. it is a good rule to limit consideration to big drives which require 200 bhp. or more. There are, of course, special cases when this will not hold.

In figuring your large plant drives as sources of process steam, there is always the probability that there will be a point when no more steam is available for drives, but there are still drives to be powered. For your remaining pumps and compressors, therefore, you have two choices: motors, or internal combustion engines. If a reliable supply of purchased power can be had at a reasonable rate, motors are the answer. But if no power is available, or the supply is unreliable, or the price is high, then you are faced with a choice between direct engine drives, or an engine-driven generating plant and motors. This becomes a special economic study.

Usually such a generating plant will be driven by an internal combustion engine. However, gas-turbine generators are being built and will probably compete with engine-generators in a few years. Of course, if the plant is a large steam consumer, a steam generating plant may be in the cards. The first requirement for steam generation of power is at least 2,500 kw. load, and preferably 5,000 kw. or more.

The easiest way to find an answer to this problem is to take the plant steam requirements. Assume that all plant steam comes from the generator drive. Then see what steam pressure would be required to produce power for the plant. If the steam pressure required is under 900 psig., you have an economic comparison on your hands. But if the pressure works out higher, you had best forget about the steam plant.

The accompanying chart shows approximate steam rates for turbo-generators exhausting at 150 and 200 psig., plotted against steam pressure. As an example, if you are using 35 lb. or more of steam per kilowatt, and have a load of 2,500 kw. or more, a steam generating plant should be considered. However, regard this conclusion with skepticism. Steam plants are expensive which means you will have to justify a large investment cost. A very broad rule is not to look at a steam plant until you have a power load of at least 5,000 kw.

The alternative of internal combustion engines may be considered. Above 200-300 hp. we have the heavy-duty, slow-speed engine which gives good service with low cost, year in and year out. But as we go down in size, the speed increases and the engine becomes lighter. Around 20 hp., we find automobile engines appearing in the field.

Of course, maintenance usually goes up with speed. However, internal combustion engines should not be discounted. They shine in intermittent service. In fact, there are many continuous services where they have stood up and performed well. The secret is to forget brake-horsepower of the pump or compressor, and choose the engine drive to exceed the torque requirements of the equipment over its entire range of use. Furthermore, the engine should not be expected to run at maximum power day in and day out. Remembering these rules should give you the engine drive service you expect.

Figuring the Load

To illustrate these points, take a new natural gasoline plant as an example. Once our process flow sheet is established, we can determine the requirements for open steam and closed steam, as well as the various equipment loads. Our next step is to tabulate the heating requirements and select the various heating media. Our tabulation will include open steam as a separate entry.

Referring now to Table I, we can see the method of attack. The first

three columns come directly from our process computations, showing the services, the duties, and the various temperature levels. Adding 40°F. to the maximum temperature level of each step gives us the heat-medium temperatures listed in Column 4. From this we can select the heating medium for each step.

Note that the fat-oil de-ethanizer is a special case, since our process computations show that this heat can be supplied by exchange with lean oil from the stripper. However, we do have a problem of control in this step and for this purpose we use a steam trimmer on the reboiler outlet to give fast, positive temperature control. We shall balance the exchanger system for fat and lean oil with a bottoms-feed exchanger on the stripper.

The third item is the stripper itself which requires too high a temperature for steam and, therefore, must either be direct fired or provided with a system using a special high-temperature heating medium.

The next three heat loads are all in the steam range as Columns 4 and 5 show. Column 6 gives the corresponding pressures at the point of the application, and in Column 7 we have added 15 psi. for control, which gives us the approximate steam line pressure required. Finally, by use of Columns 2 and 7, we calculate the required pounds per hr. of steam for each load as in Column 8. We are now ready to select the steam pressure levels.

The top required pressure is that in the fat-oil de-ethanizer which is listed as 220 psig. at the header. This suggests a standard 250 psig. steam system as the obvious answer. We will thus have more pressure drop and better flexibility for temperature control, having set our live-steam system at 250 psig. The remainder of our closed steam totals 18,000 lb. per hr. Of this, over 14,000 lb. at 43 psig. is needed for the depropanizer and the debutanizer. The remainder, at lower pressures, is small so it obviously would be uneconomical to provide a separate system for these. The

Steam and Other Heat Requirements for a Natural Gasoline Plant—Table I

Equipment	Heat Req., MM Btu. per Hr.	Temp. Level, °F.	Heat Med. Temp., °F.[1]	Heat Medium	Steam Press., Psig. At Temp.	Steam Press., Psig. Add 15 Psi. for Control	Steam Req., Lb./Hr.	Pressure Selected, Psig.
Closed Steam								
Fat-oil de-ethanizer	55.0	175–350		Lean oil				
	+10.0		390	+10% Steam	205	220	12,000	250
Rectifier reboiler	0.7	200	240	Steam	10	25	770	50
Stripper	35.0	450–550	590	Direct fired	.....	.....	.....	.....
Depropanizer	10.0	250	290	Steam	43	58	11,000	50[2]
De-ethanizer	2.7	170	210	Steam	0	15	3,000	50
Debutanizer	3.0	250	290	Steam	43	58	3,300	50[2]
Open Steam								
Stripper	.....	.....	.....	Steam	135	150	13,500	150

Total Steam Requirements, Lb./Hr.

250 Psig.	150 Psig.	50 Psig.
12,000	13,500	18,070

[1] For temperature head add 40°F. to maximum temperature level.
[2] See text on use of condensate control to eliminate need for excess pressure for control.

Selection of Steam Drives for a Natural Gasoline Plant—Table II

Service	All Pumps: No. Req.	Flow Rate, Gpm.	Press. Rise, Psi.	Liquid Hp., LHp.[1]	Recip.: Est. Steam, Lb./Hr.[3]	Centrifugal: Brake Hp., BHp.[3]	Centrifugal: Est. Steam, Lb./Hr.[4]	Selection: Service	Selection: Spare	Exhaust Made: 150 Psig. Lb./Hr.	Exhaust Made: 50 Psig. Lb./Hr.
High-pres. lean oil	2	450	800	210	84,000	323	35,600	Centr. motor	Centr. motor	.....	.....
Absorber intercooler	2	600	40	14	5,600	21.5	2,400	Centr. motor	Centr. motor	.....	.....
Low-pres. lean oil	1	175	230	23.5	4,700	36	2,000	Centr. turb.	Centr. motor	.....	2,000
Fat-oil de-eth. reboiler	1	1,800	80	84	16,800	129	7,100	Centr. turb.	Centr. turb.	.....	7,100
Heater circulation	1	1,600	100	93	18,600	143	7,900	Centr. turb.	Centr. turb.	.....	7,900
Stripper reflux	1	500	50	14.6	2,900	22.5	1,250	Recip.	Recip.	2,900	.....
Depropanizer feed	1	160	210	19.6	3,900	30	1,650	Recip.	Recip.	3,900	.....
Depropanizer reflux	1	225	50	6.5	1,300	10	550	Recip.	Recip.	1,300	.....
De-ethanizer feed	1	100	265	15.5	3,100	24	1,350	Recip.	Recip.	8,100	.....
De-ethanizer reflux	1	80	40	1.9	400	3	200	Recip.	Recip.	400	.....
Debutanizer reflux	1	70	55	2.2	450	3.5	200	Recip.	Recip.	450	.....
Cooling water	4	5,000	31	90	.....	106	23,400	Centr. motor	Centr. motor	.....	.....
								Exhaust produced		12,050	17,000
								Exhaust required		13,500	18,070
								Live steam makeup		1,450	1,070

[1] LHp. = Gpm. × Psi./1,714.
[3] With drop through cylinder from 250 psig. to 150 psig. assume 200 lb. steam required per LHp.
[3] Assume 85% efficiency for cooling water pumps, 65% for all others.
[4] With drop through turbine from 250 psig. to 50 psig., assume 55 lb. steam required per BHp.

answer is a single exhaust steam system for all of the reboilers. For the low-pressure applications we can throttle the steam to the reboiler and control temperature by varying the pressure in the reboiler. Or instead, we can throttle the condensate and control the temperature by partial flooding of the tubes. The first method would require about 15 psi. drop for control and perhaps another 10 psi. for flexibility. This would mean a total pressure of 60-70 psig. for the exhaust system, which is a little high for mechanical-drive turbines. On the other hand, using condensate control requires 43 psig. minimum. If we add a little pressure for flexibility, we could set this exhaust system at 50-55 psig. This is about the highest back pressure that we can expect with small turbines, so that we would pick condensate control and a 50 psig. exhaust system for this service.

The last item in Table I describes the open steam requirements for the stripper. This would require a pressure of 135 psig. at the nozzles, with 15 psi. for control, bringing this up to 150 psig. Thus we can use a 150 psig. exhaust system. However, this is too close to our 250 psig. live steam pressure to use turbines as the throttling method, so we would use reciprocating pumps here.

To sum up thus far, we will plan on 250 psig. live steam, a 150 psig. exhaust system from reciprocating pumps, and a 50 psig. exhaust from turbine-driven centrifugal pumps. We are now ready to select our drives.

Selecting the Drives

Our first problem is to consider all of the plant drives and determine which should be used for steam pressure reducing service. All intermittent service should be culled from the list since they can easily upset a well-balanced system. These preferably should be non-steam drives. In addition, the boiler feed pumps can also be taken from the list since their exhaust is usually used to preheat and deaerate boiler feed water. This leaves the continuous-service drives, chiefly pumps and compressors, to be analyzed.

Table II lists the continuous-service pumps for our assumed natural gasoline plant. It shows the number required, their capacity, differential pressure and hydraulic horsepower. All this information comes from our process design. The next step is to set up the steam each service would require, using a reciprocating pump, and using a turbine-driven centrifugal. In this operation a little judgment goes a long way.

After listing the pumping pressure requirements for each of the services we calculate the hydraulic (liquid) horsepower for each, and then the approximate steam consumption for both reciprocating and centrifugal pumps for this service. The easiest way to determine the steam consumption for steam pumps and mechanical drive turbines is to consult suppliers of these pieces of equipment. However, we can make a quick estimate, using 200 lb. of steam per hydraulic horsepower for the reciprocating pumps and 55 lb. per brake-horsepower for the centrifugal pumps. In the latter case we determine brake-horsepower from hydraulic horsepower by using 85% efficiency for the cooling water pumps, and 65% for all others.

From the table we can see immediately that reciprocating pumps would not be suitable for the cooling water service. In the case of all others it is necessary to choose between reciprocating pumps and centrifugals, depending on our exhaust steam requirements.

First we go back to Table I and list our exhaust steam requirements as 13,500 lb. per hr. at 150 psig. and 18,070 lb. per hr. at 50 psig. Then we attempt to move figures from Column 6 to Column 11 so that they will total less than 13,500; and from Column 8 to Column 12, to total less than 18,070. But in doing so we must consider which services would be out of reason for reciprocating pumps. That is, we select the low to moderate capacity services for the reciprocating pumps and in so doing produce 12,050 lb. per hr. at 150 psig. exhaust pressure.

Working then on the centrifugal pumps, we find that three of the drives will produce 17,000 lb. per hr. as compared with 18,070 required. The difference here is less than 10% so that the system is likely to blow to the air if the load drops. To get flexibility which will avoid this, we select a non-steam drive for the spare low-pressure lean-oil pump.

This still leaves us with several process pumps and the cooling water pumps which will not have steam drive. Our basic choices here include motors operated on purchased power, direct internal combustion engine drive, and finally motors operated by local generators. Since these pumps will require only about 950 kw., we can easily eliminate the alternative of a generating plant to produce electricity for these motors. This is too low a load for a steam-generating plant, as we will find in referring back to the chart showing the steam pressure required for these conditions. With a total steam load of 33,500 lb. per hr. and an electric load of 950 kw. this is about 35 lb. per kw. With 250 psig. back pressure we would need about 900 psig. boiler pressure, so a steam generating plant washes out on both the pressure and the electrical capacity counts.

The economic choice from among the other various methods will vary from plant to plant. There can be no set rule short of taking actual conditions, putting them down on paper, and making a comparison. However, if a reliable source of power is available at the plant for about 7 mills per kilowatt-hour, then motors will usually be the least expensive drives to install, although not by much. Their power cost is the big item. You can, of course, generate the power yourself if you want to pay for the generating equipment. But the chances are that your annual operating cost will be about the same because of extra maintenance and depreciation on this relatively small scale generating equipment. The same holds true for internal combustion engine drives. The difference between the fuel and the power bills is eaten up by the maintenance and depreciation.

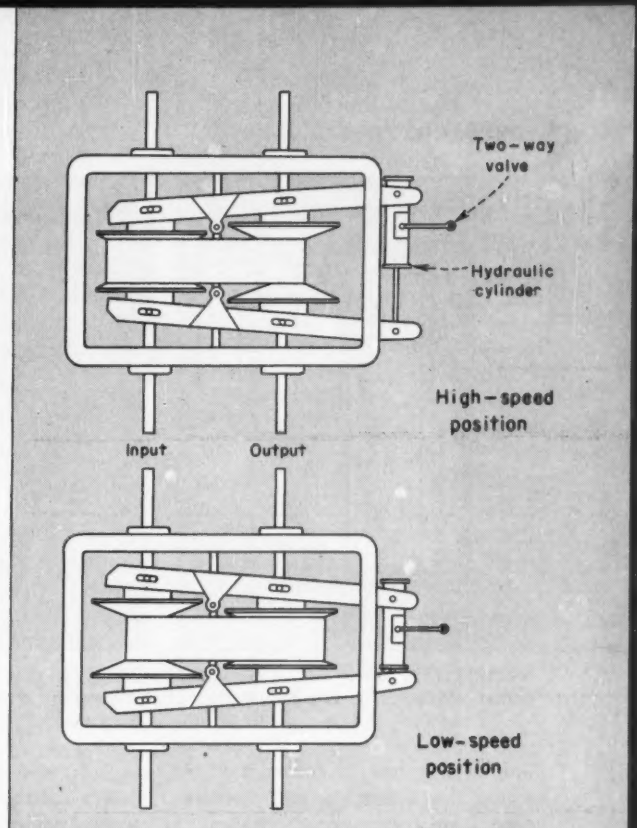
Throughout this entire analysis the figures used have been approximate and accurate to something better than 10%. This is about as close as design can come to actual plant operation. A little judgment, plus a pattern of attack as described here, should give you the equipment drive selections you will require for good plant operation.

Variable Speed for Process Control

▲ **WHAT:** Engineering evaluation of equipment and methods for automatic process control through combining a constant-speed electric motor and a simple variable-speed mechanical transmission.

▲ **WHY:** Simple and low in cost, these methods will become more important as automation gains momentum; a pioneering roundup of the entire field for chemical engineers, emphasizing improvements that are making automatic speed control feasible.

▲ **WHO:** For engineers in plant operations and design throughout the chemical process industries, particularly those in instrumentation and process control.



COMMON type of V-S drive has cone-type sheaves—(Fig. 1)

RICHARD LE BARON BOWEN, JR., Coated Textile Mills, Inc.

AUTOMATIC control—automation as it is being much publicized today in the mechanical industries—is an old story in process industries. Even here, however, it is undergoing change and developing rapidly. One of the most important areas where improvement is coming about is in automatic speed control. The combination of a constant-speed electric motor with a mechanical variable-speed transmission is an old and popular method of achieving variable speed. The low initial cost and inherent simplicity of such units have never been matched by any form of wholly electrical variable-speed equipment.

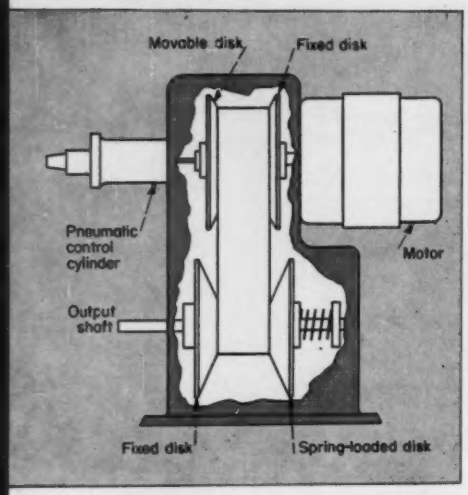
Although there have been a few methods of varying the speed of these transmissions automatically or under remote manual control, it is only quite recently that thoroughly satisfactory control methods have been developed.

Variable-Speed Mechanisms

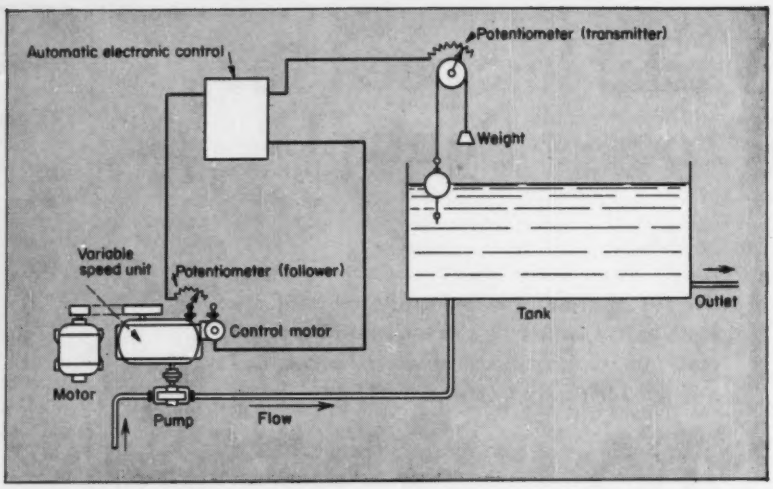
The commonest form of mechanical variable-speed transmission—Fig. 1—consists of a pair of parallel shafts with variable-pitch pulleys mounted on each shaft. A V-belt usually provides the driving connection between the two shafts. One form of shifting mechanism consists of a pair of levers which press against each disk, and are pivoted at a point between the pulleys. One end of each of the levers is connected by some device which will move the ends of the levers in and out. The oldest and still one of the most frequently used means of connecting the lever extensions is a screw-threaded shaft. Turning the screw shaft in one direction moves the disks of one pulley closer together and at the same time moves the disks of the other pulley apart. The pulleys are designed so that proper belt tension is maintained at all times. In Fig. 1 the ends of the extended shifting levers are shown joined by a hydraulic cylinder for positioning the disks.

Transmissions of this type operated by means of a shifting screw are manufactured by such concerns as Reeves Pulley Co., Allis-Chalmers Mfg. Co., Lewellen Mfg. Co., and Link-Belt Co. Reeves and Lewellen use wide V-belts made of a composite rubber belt reinforced with leather-tipped wooden blocks, while Allis-Chalmers uses multiple V-belts. In the Link-Belt PIV transmission the conical faces of the disks have radial grooves which receive a unique self-tooth pitching steel chain.

In another type of arrangement, a mechanically adjustable variable-pitch pulley is mounted on a motor shaft which projects into the transmission housing. A spring-loaded variable-pitch pulley is mounted on the output shaft. A system of levers moves one disk of the mechanically adjustable pulley in or out, and the spring-loaded pulley automatically changes its pitch diameter, simultaneously and oppositely. This type of arrangement is invariably found on totally enclosed units with an integrally mounted motor. It is manufactured by firms including Reeves Pulley Co. and U. S. Electrical Motors. A typical



MOTORIZED drive with spring-loaded output sheave is popular type—(Fig. 2)



ELECTRONIC automatic speed control system positions V-S drive proportional to demand by means of pilot motor and two potentiometers, one a follower—(Fig. 3)

unit of this type is shown in Fig. 2 where the adjustable pulley is connected to a pneumatic cylinder. A variable speed transmission with integral motor is often called a "drive."

These two arrangements of dual variable-pitch sheaves account for perhaps 80% of the mechanical transmissions manufactured. The first type of transmission is usually built without motor and can be supplied in sizes up to 87 hp., with speed ranges between 2:1 and 16:1 (lowest ranges at highest power). The drives of the second class with integrally mounted motors are supplied in standard sizes from ¼ hp. to 30 hp. and are available on special order up to 50 hp., with speed ranges limited to 6:1 in the larger sizes.

Transmissions with variable-pitch sheaves have a relatively limited range of speed adjustment. One method of getting around this limitation is provided in a differential manufactured by the Speed Control Division of Fairchild Engine and Airplane Corp. This concern builds the differential integral with a Link-Belt PIV drive. The arrangement permits reaching output speeds down to zero and into reverse.

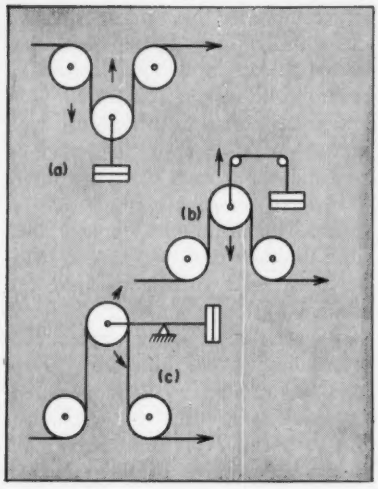
A great many methods of achieving variable speed mechanically have been introduced from time to time, but few of them other than the types described have survived. One of the exceptions is a drive manufactured by Graham Transmissions, Inc., consisting of a number of tapered friction rollers which revolve against a stationary steel ring. The rollers are free to rotate in a carrier which is driven at constant speed. Movement of the steel ring from one end of the rollers to the other causes variation in the rotation speed of the rollers as they roll on different diameters. One end of each roller is fitted with a gear meshing with a ring gear on the output shaft. Therefore, moving the ring longitudinally changes the speed of the rollers and hence the output speed, which can be reduced to zero or into reverse. Such units are made in sizes from 1/15 to 5 hp.

Automatic Control of Speed

Automatic control of mechanical variable speed transmissions is a relatively recent development of power transmission. The first forms of automatic control consisted of little more than conventional mechanical transmissions fitted with small electric positioning motors for turning the shifting screw. These were originally added to transmissions so that they could be remotely controlled at points removed from the transmissions. Most manufacturers of this type of equipment can supply these positioning motors as standard equipment. The pilot motor simply changes the output speed of the units, either faster or slower. Push-button control usually consists of "on," "off," "fast," and "slow."

Electronic Control — Fully automatic control is possible using an electric pilot motor with an electronic control system. Control is produced by electronically amplifying the signals of process variables for operating the pilot motor. Two potentiometers (variables resistances) are connected to form a bridge circuit, as in Fig. 3. Movement of one potentiometer, called the "transmitter," actuates the pilot motor. The second potentiometer, called the "follower," is driven by the pilot motor and turns when the pilot motor turns. Thus the follower potentiometer automatically balances the system before the pilot motor can overshoot or move too far. Without this follow-up principle, the pilot motor would shift the transmission either completely to high or completely to low speed, since complete shifting takes only a matter of seconds. Then the transmission would simply hunt between high and low speed. However, in the case of the electronic control with dual potentiometers, the transmission actually shifts an amount proportional to the movement of the transmitter potentiometer. Concerns such as Link-Belt and U. S. Electrical Motors have both manufactured this type of control.

The sensing element (e.g., the float in Fig. 3) has to be able to produce a rotary or linear motion with a force of an ounce or so for turning the transmitter potentiometer. One of the possible uses of this type of equip-



TENSION measurements use floating or balanced rollers—(Fig. 4)

ment is for the control of tension in web materials. A web of material is passed over a movable roller which is counterbalanced with weights to give the proper tension. Too much tension over-balances the weights and moves the roller in one direction, while too little tension moves the roller in the other direction. The roller is linked to the potentiometer.

There are two basic ways in which tension can be detected. In Figs. 4a and b the roller moves in vertical guides and is called a "dancer," "floating," or "compensator" roller. In this type of arrangement there is usually a pair of idler rollers above or below the floating roller and the floating roller is mounted in a stand to keep it parallel at all times. The floating roller can be either "direct" or "inverted." The other type of arrangement (Fig. 4c) is known as a "teeter" or "balance" roller and is pivoted at the center of an arm and counterbalanced on the other side of the pivot point. This type is more sensitive, because the friction is almost negligible when compared to the vertically guided type. However, the pivoted type is seldom used because of the larger space requirements and because the roller movement is more limited.

There are two applications for this type of tension control in the processing of web materials. One is the winding of materials as they leave process machinery. The movable roller controls a variable-speed transmission which drives the winding shaft on which the web material is wound. In the other case the movable roller controls the speed of one stage of the processing machinery, so that the web can pass from one stage to another at a predetermined tension. An example of this latter case is found in "range drives" for cloth, such as multi-compartment washers where the speed of squeeze rollers is controlled to maintain constant tension. "Range drive" is the term applied to any series of machines which are grouped together to process web material continuously.

Since a potentiometer can be operated by an ounce or two of force, it is evident that a tension of 100 lb. can be maintained with an accuracy of one-tenth of 1%. However, if slight tensions of less than 1 lb. are required, the accuracy would be about ±10%. Usually such accuracy is quite acceptable in these cases.

Another problem that can be solved by this type of electronic control is that of controlling liquid levels (Fig. 3). The variable-speed transmission drives a pump, and the transmitter potentiometer is connected to a float, or to the stem of a diaphragm motor which is in turn actuated by the pressure of the liquid. The device can also be used to control the rate of coal feed to a furnace, the potentiometer being moved by a diaphragm motor actuated by the boiler pressure. However, since the sensing means must produce a linear or a rotary motion with a force of several ounces to move the potentiometer, the applications of this type of control are inherently limited. Besides, there is always a certain amount of hunting in the mechanism inherent in its design.

This same arrangement of a pilot electric motor and two potentiometers can be used to position remotely adjusted variable-speed transmissions with great accuracy. A control knob is connected to the rotating element of the transmitter potentiometer, and a calibrated dial is suitably marked with speeds or percentages of maximum speed. The control knob turns the transmitter potentiometer which actuates the pilot motor. This changes the speed of the transmission until the follower potentiometer again balances the bridge circuit. The remote control can be located at any distance from the transmission, the only connecting means being wires.

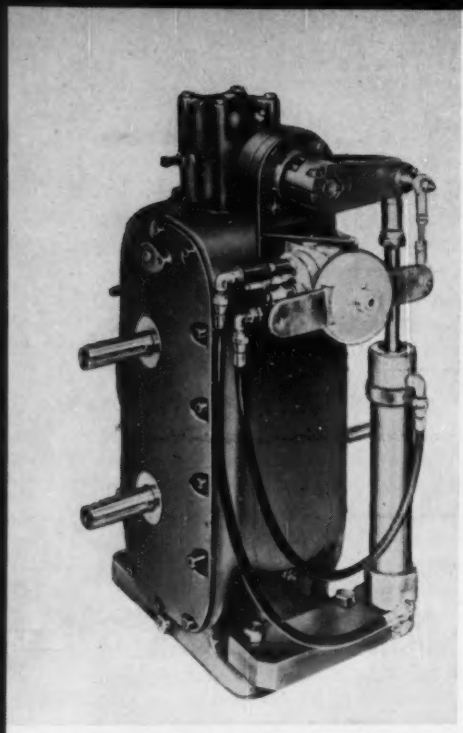
An electric pilot motor can be remotely controlled without any electronic control, simply using a two-button push-button station without any indication of the speed. With a generator-operated tachometer mounted near the push-button station, the speed can be determined, but only by trial-and-error. The electronic control gives an ease of setting not otherwise obtainable.

Hydraulic Control—Reeves, Link-Belt, and others have developed hydraulically controlled variable-speed transmissions for the purpose of automatic control (Figs. 1 and 5). A double-acting cylinder is connected to the shifting mechanism of the transmission. The cylinder is in turn controlled by a two-way control valve actuated by a lever connected to some sensing mechanism of the process.

When a speed change is required, the valve admits fluid into the cylinder either above or below the piston, to increase or decrease the speed. The



R. LE B. BOWEN, JR., is president and treasurer of Coated Textile Mills, Inc., Pawtucket, R. I. Taking his BS in chemistry at Princeton in 1941, he later attended MIT, earning his MS in 1943 and his ScD in 1949, both in chemical engineering. In 1944-8 he was a design and construction engineer with Aramco in Saudi Arabia. In 1950 he served as engineering advisor with an archeological expedition in South Arabia. Dr. Bowen's outside interests lie in archeology, ethnology, and marine biology, in which fields he has written extensively. He is considered one of the world's leading authorities on primitive watercraft.



HYDRAULIC control of V-S drive is used in this Link-Belt PIV—(Fig. 5)

valve itself is linked to one of the moving parts of the cylinder so that, in correcting a speed variation, the cylinder moves the valve in a direction which tends automatically to stop further movement. The control is thus self-neutralizing and therefore has little tendency to over-run the control point and start hunting.

With this arrangement there is a definite, predetermined output speed for every position of the valve control lever. When the valve lever is moved, the speed is changed an amount which is proportional to the movement of the lever. Once a speed setting has been made, the pressure in the system acts as a brake to hold the valve in a neutral position until further change is required.

Transmissions with hydraulic controls are usually equipped with a self-contained hydraulic power plant consisting of an oil tank, a pump, a pressure-regulating valve, and a motor to drive the pump. This power plant supplies oil under constant pressure for operating the cylinder. However, the control can also be operated with air pressure. When pneumatic control is used the air supply is connected directly through a pressure regulator, filter, and lubricator. A different type of valve is used for air, but the operation is the same.

The kinds of automatic control which these hydraulically controlled transmissions can handle satisfactorily are the same as with the electronic control. The first of these is tension, with the sensing element either a floating roller or a balance roller. The floating roller is more commonly used. It is connected to the valve lever by means of a small cable. Only a few ounces of force is required to move the valve lever. This type of control can also be used for liquid level control and stoker feeds. However, the application of these fluid-controlled transmissions is basically limited in the same manner as the electronically controlled transmissions, since the sensing element must produce a linear or rotary motion with sufficient force to operate the valve lever. In some types of control there will also be a certain amount of hunting. However, in such applications as the control of web tension in winding, where the speed is being varied continuously, speed change is accomplished without hunting.

Electro-Hydraulic Control—We have seen above that the electronic type of control can be used for range drives, and indeed there have been several such installations. Some have worked without trouble for long periods of time, but invariably most of them have developed troubles of some kind. Since the mechanism is primarily electrical, and secondly electronic, any of the very minor breakdowns which occasionally occur to this type of equipment—for example, fuse or tube failures—will completely shut down the machinery. While the failure is usually minor, finding the difficulty quickly and efficiently is quite another problem. It is for this reason that none of the manufacturers of the electronic type of control recommend their equipment for range drives at the present time. But this type of control is certainly no more complicated than electronically controlled variable-speed motors.

Reeves Pulley Co. has developed a range drive using an electrical control in association with its hydraulically controlled transmissions. The control equipment consists of a main control circuit which can be manually adjusted, and an automatically controlled circuit which is responsive to any change in the tension between the separate units. Manual control is accomplished by turning a single dial which turns ganged rheostats connected to each drive. Each manually controlled rheostat is balanced with a rheostat located in a Modutrol type motor which operates the hydraulic control lever of each individual drive. When the manual-control dial is turned, the Modutrol motors turn until the rheostats connected to them are once again balanced against the manual-control rheostats. This is somewhat similar in operation to the electronic control discussed above where transmitter and follower potentiometers were used to accomplish the same end. However, there is no electronic system in the Reeves range drive.

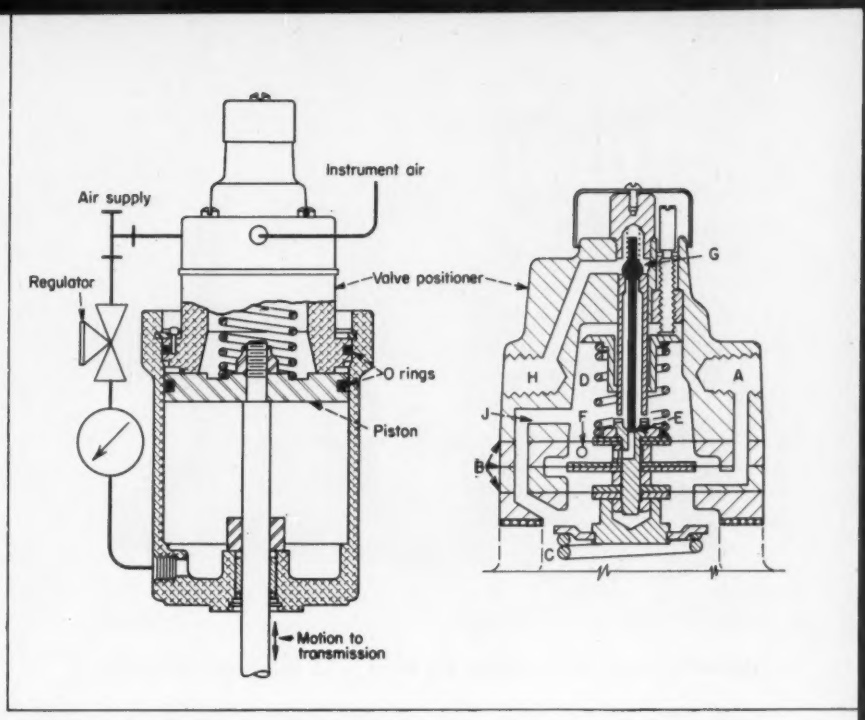
Since it is impossible to synchronize any group of electrical controls, a floating roller is used with each of the units except the lead unit. Movement of any of these rollers turns an associated rheostat which actuates the corresponding Modutrol motor in the same manner as the manual control. The circuiting is such that any Modutrol motor is responsive to either the manual control of its own floating roller.

Magnetic brakes are installed on each drive and are adjusted to overcome the individual inertia of each driven section so that each section stops about the same time.

It should be evident that this type of mechanical variable-speed range drive is similar in performance to variable-voltage drives using dc. current. The mechanical variable-speed system has an obvious advantage in that it uses ac., it has no electronic components, and can use full motor horsepower at all times, obtaining the variable speed from the mechanical transmissions.

Pneumatic Control—It might seem that speed control could be put on the same basis as that of a diaphragm control valve by simply adding a diaphragm motor to a mechanical variable-speed transmission and controlling this by a pneumatic controller. However, the spring-and-diaphragm motor usually does not have enough travel to shift most of the variable-speed transmissions, and often it does not have enough power to shift the larger units.

The recent development of the



AMPLE power for high-accuracy adjustment of V-S drives under pneumatic instrument control is claimed for Conoflow Corp.'s piston-type control cylinder—(Fig. 6)

Conoflow Corp.'s pneumatic control cylinder, known as the cylinder "Conomotor," has revolutionized handling of automatic mechanical variable-speed control. Now a variable-speed transmission can be actuated in the same manner as a diaphragm-motor control valve by any sort of pneumatic controller. This readily makes speed control available for controlling temperature, pressure, flow rate, humidity, pH, liquid level, viscosity, and other variables.

The Conoflow control cylinder (Fig. 6), was originally developed to overcome certain inherent disadvantages of the simple spring-and-diaphragm motor nearly always used on process control valves. Because spring-and-diaphragm motors conventionally use 15-20 psi. instrument air, their speed of response is slow compared to that theoretically possible with 80-100 psi. air. Furthermore, the unbalanced forces in even double-ported "balanced" valves usually destroy the most important characteristic of the valve, the "proportional position" functioning, which is often produced by the main valve spring. Once a positioner is added to the valve, the main spring no longer has to provide proportional position, since this function is then done by the valve positioner spring.

The Conoflow control cylinder does away with the main spring and loads the underside of the operating piston with a "cushion" of air, a more versatile and adaptable means of underside loading. Since plant air at 80-100 psi. can be used for loading the piston, and since the volumes involved in full travel are small, the cylinder Conomotor is five to ten times faster in speed of response than the spring-and-diaphragm motors, and has a repositioning accuracy and stability unobtainable with diaphragm motors. Besides this, stem travels of 3-4 in. are standard with the cylinder Conomotor. It is this last feature which makes the device readily adaptable to mechanical variable-speed transmissions for automatic control.

The cylinder Conomotor was first standardized by Link-Belt in 1950 as an accessory mechanism for automatic speed control. Since then Reeves, U. S. Electrical Motors, Sterling Electric Motors, and Graham Transmissions, Inc., have all standardized the cylinder Conomotor as a control device.

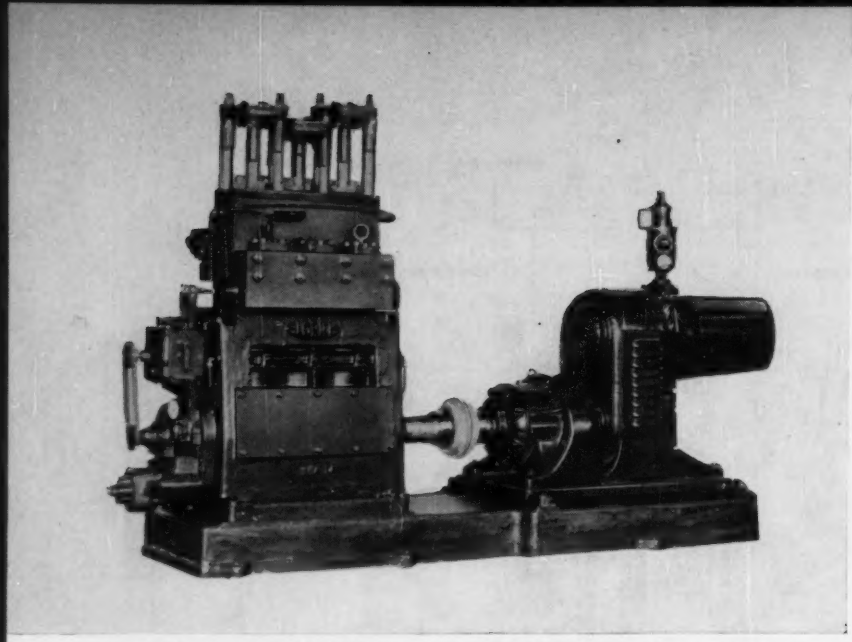
The Conoflow control cylinder consists essentially of a valve positioner mounted integrally with a pneumatic cylinder, as shown at the left in Fig. 6. Reduced plant air is introduced under the piston head which takes the place of the conventional diaphragm. The valve positioner introduces full air pressure over the piston, moving the stem downward. If the underside air is reduced to say 40 psi., then with either 80 psi. or 0 psi. on top of the piston there is a maximum thrust of 504 lb. developed in either direction with a 4-in. diameter cylinder.

The positioner, shown at the right in Fig. 6, operates on the force-balance principle. Controlling instrument air entering at *A* exerts an upward force on the largest of the three diaphragms *B*. Added to this is the thrust of the range spring *C*. Balanced against this upward force is the force of the suppression spring *D*, so any increase in instrument air pressure will temporarily close exhaust *E* to vent *F*, and lift ball pilot valve *G*. This allows high-pressure air entering at *H* to flow down on top of the power piston through *J*, thus reducing the thrust of range spring *C* until the forces are again balanced at the piston position called for by the control pressure. Loading under the piston remains constant due to the action of the regulator. It is claimed that positioning is accurate within 0.002 in.

The Conoflow control cylinder is being used as standard equipment for automatic control on transmissions of both the variable-pitch-sheave type, and the tapered-roller type. The first include the Link-Belt PIV chain belt transmission, and the totally enclosed drives with integrally mounted motors made by U. S. Electrical Motors, Reeves, and Sterling Electric Motors. (See, for example, Figs. 2 and 7.) The second is the Graham transmission, shown in Fig. 8. In the integral-motor, variable-pitch-sheave types the Conoflow cylinder is linked to the mechanically adjustable pulley mounted on the motor shaft so as to push the movable disk toward its mate. In the PIV drive the Conoflow cylinder is linked to the shifting lever projecting from the drive housing. In the Graham, the Conoflow cylinder moves the control ring of the transmission, thereby changing the speed ratio. Fairchild Engine's differential transmission can also be fitted with the Conoflow control.

Flow-Rate Control

Conoflow-controlled variable-speed transmissions can be operated by any type of pneumatic controller, sensitive to any process variable being con-



ABRASIVE slurry pump (Aldrich) is powered by U. S. Electrical drive—(Fig. 7)

trolled through the speed of rotation of some piece of process equipment. Often this is a pump.

One of the long accepted methods of controlling fluid flow in continuous liquid processing systems is to pass the liquid through a centrifugal pump, place a diaphragm-motor control valve in the discharge line, and control the valve with a pneumatic controller actuated by an orifice or other means. Under conditions requiring zero flow, the controller shuts the valve completely and the impeller of the pump simply turns at constant speed against a closed discharge. The availability of variable-speed transmissions which can be actuated very accurately by conventional pneumatic controllers introduces a new concept of automatic flow control.

Now it is possible to have a positive displacement pump—such as a reciprocating or a rotary pump—driven by a pneumatically controlled variable-speed transmission. The flow can then be controlled by varying the pump speed, as in Fig. 7. From an initial cost consideration it would not seem that a variable-speed transmission with Conoflow control could ever feasibly replace a simple diaphragm control valve. However, this type of control has a very valuable place in the precise control of flows. Such equipment is now being used for many automatic process controls in the chemical industry in proportioning, metering, blending, treating, and sampling.

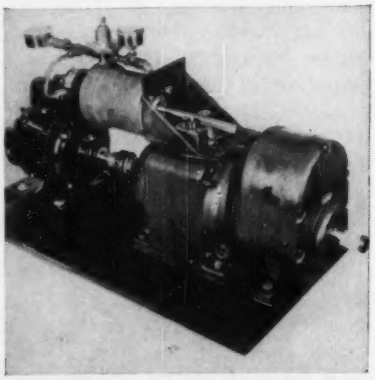
Thus in a typical blending or treating application, such as that of Fig. 9, a secondary stream of liquid can be added in quantities proportional to the volume of the primary flow. Fig. 9a shows an open-loop and Fig. 9b a closed-loop system, the latter having the actual volume of the secondary flow measured and corrected if it is not absolutely proportional to the primary stream. In most proportioning applications the secondary fluid is fed into the system in an open-loop system (Fig. 9a), meaning that the system has no way of detecting or correcting an error it it should fail to deliver a proportional amount. However, most controlled volume pumps are precision flow-control instruments whose output is accurate to 1% or better.

In most open-loop flow-control systems, the controlling variable is the flow rate in a primary stream, and the controlling mechanism is a pump. Several proportioning pump manufacturers have used Conoflow control cylinders to vary pump speeds in automatic proportioning applications. Typically, the primary flow may be measured by a special positive-displacement liquid meter which adjusts an integrally mounted pilot valve, in turn controlling the operation of the controlled volume pump handling the secondary stream.

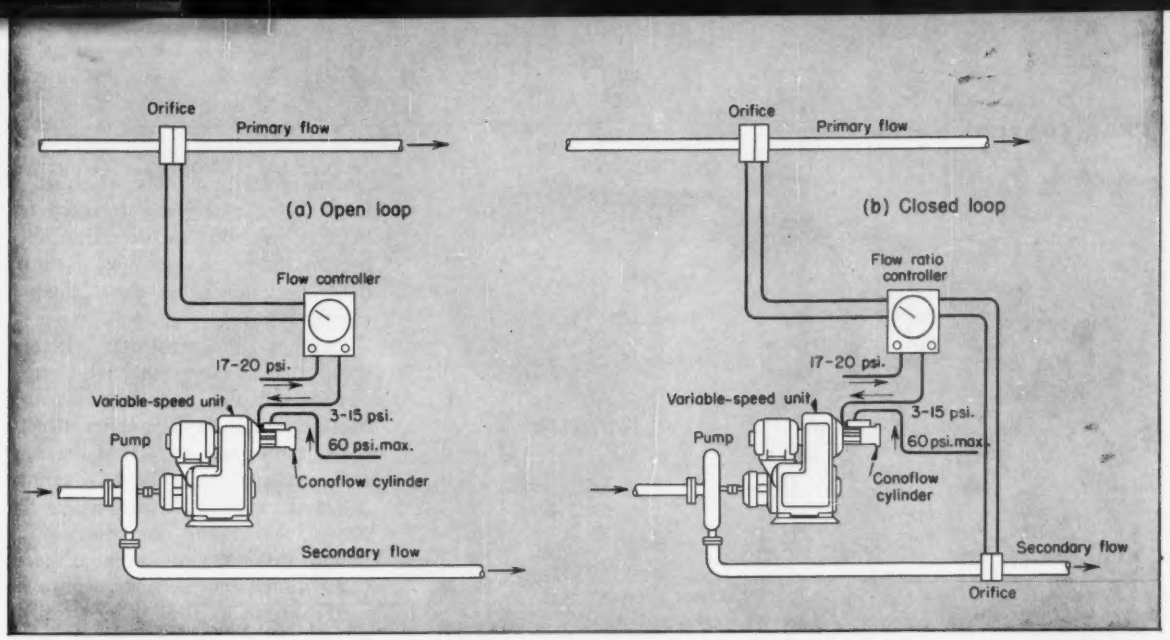
In the chemical industry, proportioning operations—such as metering, blending, treating, and sampling—are present in numerous processes. In blending, several liquids are to be added together and agitated to produce a blend possessing the desired properties. With pneumatically controlled pumps, a number of streams can be exactly proportioned by a single control, or several liquids can be added in proportion to the flow of a primary stream. Most treating applications require comparatively small percentages of some chemical to be added to a main stream. Since treating involves a chemical change, the combined liquids are usually passed into a reactor of some sort. Sampling is a very important control check on both the raw materials received and the end products manufactured. Proportional sampling of these materials therefore provides a quantitative and qualitative sample of all material which has passed through the line.

In the majority of treating, blending, metering and sampling operations, open-loop control systems can be used. In some, it is the only practical system. Such is illustrated by blending and sampling. In blending, all streams can be open-loop systems, controlled by a single pneumatic-pressure-control station. In sampling, the controlled volume pump is actuated by the flow rate of a primary stream.

However, in some operations a closed-loop system can be uitilized, feed-back making the system inherently more stable. This can be illustrated by a treating problem. First, considering an open-loop system, the pH of the primary stream can be measured by a pneumatic controller, which actuates a controlled volume pump and meters into the primary stream an amount of reagent which



TAPERED roller transmission (Graham) has Conoflow control—(Fig. 8)



TYPICAL proportioning pump control, with open-loop setup at left, closed-loop at right—(Fig. 9)

has been established by laboratory tests as the correct amount. However, by simply changing the pH measuring point, the system can immediately be converted to a closed-loop system with feed-back control. Here the pH measurement is made downstream from the reagent addition. The pneumatic controller now actuates the pump to control the actual measured pH, whereas before it added reagent in an amount calculated to produce the desired pH. A typical use for such equipment in the chemical industry is illustrated by the continuous polymerization of butadiene for accurately metering inhibitors, modifiers, antifoam, and short stop agents. Some can be added on open-loop systems, others must be closed-loop.

Automatic proportioning is also used in the processing of solid materials. An example is a new continuous method of devulcanizing rubber (*Rubber Age*, July 1954). Using automatic bulk-weighing feeders and liquid metering the processing time has been cut from 10 hr. to a matter of minutes. Here a gravimetric belt feeder continuously weighs and feeds screened and sifted crumb rubber to a double-screw mixer. Controlled volume pumps are actuated by the actual weight of crumb rubber fed, and feed proportional amounts of oxido-plasticization agents and softening oils into the screw mixer. Reclaimed rubber is automatically extruded in sheets.

In many instances open-loop control is very desirable, a fact well illustrated by certain difficult-to-handle liquids and suspensions. With pneumatically actuated controlled volume pumps, highly corrosive solutions and extremely abrasive suspensions and slurries can be metered or blended accurately with relative ease. The actuating variable can be the flow rate of another stream, or it can be the pH or viscosity of this stream, which is often of a non-corrosive nature. The pumps can be specially constructed to withstand the service, and there is no need for measuring any variables in the corrosive phase of the operation.

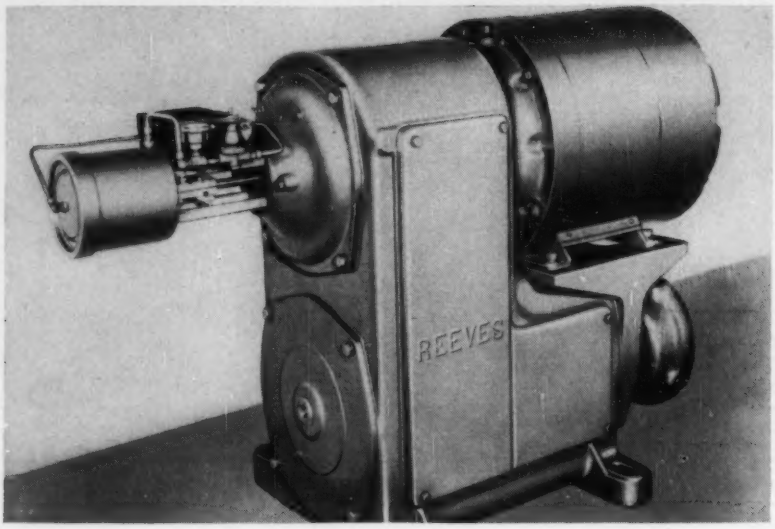
Nitration is a good example of such corrosive conditions in the chemical industry. Here difficult-to-handle fuming nitric acid can be metered into the system by pneumatically controlled variable-volume pumps which are constructed of special materials. Some proportioning pumps lend themselves readily to the use of non-metallic materials in the liquid end. Among these are ceramics, Teflon and Kel-F plastics. Such a pump is the diaphragm-type Pulsafeeder made by Lapp Insulator Co. Other manufacturers such as Proportioners and Milton Roy can supply corrosion-resistant designs. All of these can be controlled by Conoflow cylinders.

One type of application where abrasive slurries are commonly handled is in high-pressure synthesis. Such slurries often contain a catalyst. Fig. 7 shows an Aldrich triplex pump designed for this type of service in the handling of abrasive nickel catalyst. The pump uses solid porcelain plungers and is driven by a Conoflow-controlled variable-speed transmission. This is only one of many cases where abrasive slurries must be handled under controlled conditions.

Transmission Characteristics

It has been pointed out above that many proportioning applications operate on open-loop systems. In all such cases it is of the prime importance that the output speed of the variable-speed device be linear with the conventional 3-15 psi. instrument air pressure. The Graham transmission with controlling Conomotor automatically produces these results, since the movement of the Conomotor actuating arm is directly proportional to the control pressure, while the output speed of the Graham varies directly with the movement of its control lever. Thus, zero speed can be obtained with a control pressure of 3 psi., and maximum speed at 15 psi., with proportional speeds between these.

Variable-speed transmissions which make use of two sets of variable-pitch sheaves inherently gives a square relation between the movement of one set of disks and the output speed. While movement of one of the disks of the unit is proportional to the change in pitch diameter of the sheave, this produces an opposite movement on the other pulley so that the change in output speed actually varies with the square of the movement of one disk.



LINEAR control of Reeves drive comes from a special positioner—(Fig. 10)

Reeves Pulley Co. overcomes the inherent non-linearity of the variable-pitch-sheave type of transmission by the use of a special Conomotor (Fig. 10) fitted with an external positioner rather than the more compact built-in positioner. By moving a characterized cam against the positioning relay, one obtains a square-root output of the Conomotor cylinder rod, compared with the 3-15 psi. air signal. By this means Reeves can obtain output speeds which are linear with the signal air pressure.

All U. S. Electric Motor models fitted with Conoflow cylinders give performances which produce a substantially linear relation between signal air pressure and output speed. This is achieved by mounting the Conoflow stem at 90° to the axis of the adjustable sheave, and connecting to the movable disk by means of a simple link. If cylinder stem movement is plotted against disk motion, it will be found that one obtains a square curve of equal magnitude and opposite direction to the relation between adjustable disk movement and output speed. Thus the two curves tend to cancel out, producing essentially linear results.

Another important need for linear performance is found in remote manual speed control. Using a manually operated pressure-regulator panel, a variable-speed transmission with a Conomotor can be remotely set at any predetermined speed, since the speed is proportional to the controlling air pressure, as shown by a gage. However, this same type of manual controller can be used satisfactorily with transmissions which do not give linear performance. In these cases a calibrated scale can be used, or a speed calibration can be put on the pressure gage dial, giving the corresponding speed for any controlling air pressure.

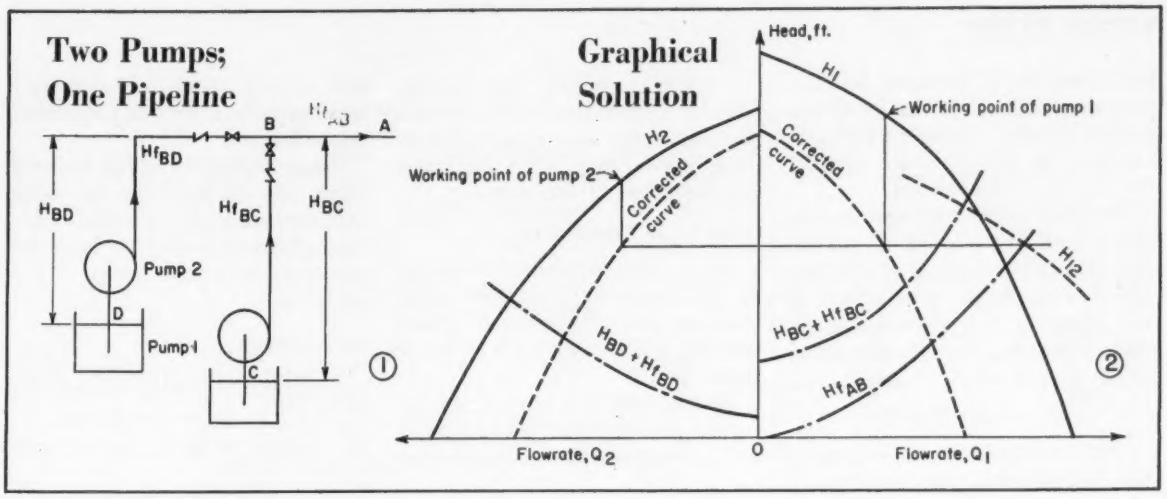
It should be noted that with variable-pitch-sheave drives fitted with a Conoflow cylinder with external positioner, exact linearity can be maintained only so long as the load does not vary. If the load varies at any particular output speed, the output speed will tend to vary slightly, since the output pulleys are spring-loaded and will vary the pitch diameter with changing load. This would be the case with a variable-speed pump, pumping against a head of fluid which tended to vary at any definite pump speed. But such a change would not be over 2%.

Generally speaking, linearity is not essential in closed-loop control systems, although it is often desirable. Non-linearity causes a difference in sensitivity from the top to the bottom of the range. In common applications, such as the control of flow, liquid level, pressure, temperature, etc., the pneumatic controllers used have proportional-band adjustments and rate-of-reset adjustments which to a large degree cancel out the need for linearity. Stability and reproducibility become the prime requisites. Both of these are inherent in the Conoflow control cylinder.

Another characteristic of variable-speed transmissions we have already considered is the possible speed range. Most types are limited inherently to about a 6:1 ratio, so that if the controller calls for zero speed, it cannot get it. In cases, therefore, where the system will require more than a 6:1 ratio of maximum to minimum speed, conventional transmissions cannot be used and one of those which can go to zero speed—for example, the Graham or Fairchild transmissions—must be used.

Most uses for pneumatically controlled mechanical variable-speed transmissions discussed above have been associated with pumping operations. Pumping applications were among the first, since pumps are the main material handling mechanisms in the chemical industry, and hence were among the first devices to go to automatic process control. However, the possibilities of this type of control are unlimited, and only a few of the potential applications have been achieved. Controlled variable-speed transmissions can power any type of equipment. Dryers, mixers, agitators, stokers, conveyors, feeders, calenders, textile equipment, and paper machinery can all be controlled by these speed control devices to extents never dreamed of.

In the case of automatic stokers a pressure controller can actuate the variable-speed transmission to vary the rate of coal fed to the fire box. With mixers and agitators the mixing speed can be varied according to viscosity, specific gravity, or other variable. Conveyors can be automatically driven in response to a force-sensitive element to deliver a constant weight of bulk material. The speed of calenders for plastic can be governed by the temperature of the film leaving the calenders. Textiles and paper can be controlled by percent dryness, thickness, hardness, stretch, or other properties. In short, the pneumatically controlled variable-speed transmissions have now become suitable elements for automatic control.



HOW TO

Rate Your Centrifugal Pumps—In Use

When centrifugal pumps feed a common pipeline their performance will vary with system conditions. Here's a simple, graphical method to find the actual working point of each pump under any set of conditions.

N. SAG, Municipal Tramways Trust

When you design or operate complex piping systems fed by several centrifugal pumps—such as a waste disposal operation—the problem of rating the performance of individual branchline pumps under variable system conditions arises.

In such a system, the main discharge pipe is usually selected with future expansion, rather than most economical operation under current requirements, in mind. In operation, the pumps are not always working simultaneously, and thus the performance of individual pumps varies.

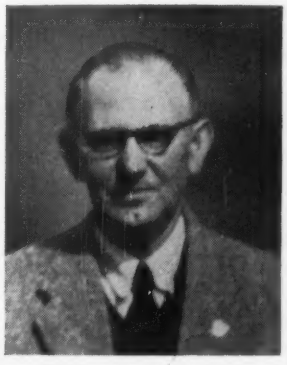
This article gives a graphical method for fixing the working points for each branchline pump at any system condition. It explains the concept of "equivalent centrifugal pump" and shows how to reduce a system with any number of branchlines to the problem of a single pump feeding a single pipeline.

This enables the engineer to judge the suitability of each pump in the system for the job it does. He can also discover the combinations in which the pumps should be used to give economical and stable operation.

In addition, a tabulation of pump performance data under various system conditions makes a useful reference for operating personnel should changes be contemplated.

Pump Characteristic Needed

Output of a single centrifugal pump feeding a pipeline depends on the pump characteristics and the pipe system characteristics. Curves supplied by manufacturers indicating how the total head developed, brake horsepower and efficiency vary with flowrate or capacity describe the pump characteristics. These curves are usually available for standard impeller speeds.



N. SAG is now development and design engineer with Municipal Tramways Trust, Adelaide, Australia. He was formerly chief design engineer for Monsanto Chemicals (Aust.), Ltd., and he's held several other engineering and teaching posts.

For intermediate speeds, reasonably accurate curves can be made. Since capacity is proportional to the rotational speed and developed head is proportional to the square of the speed, corresponding points on head-capacity curves for speeds n_1 and n_2 fit the equations:[1]

$$Q_2 = Q_1(n_2/n_1)$$
$$H_2 = H_1(n_2/n_1)^2$$

Getting System Characteristic

The pump delivers against a total

Nomenclature

D	Inside diameter of pipe, in.
H	Developed head, ft.
H_f	Head loss due to friction in piping system, ft.
L	Length of pipe plus equivalent length of valves and fittings, ft.
Q	Flowrate, gpm.
f	Coefficient of pipe friction.
n	Rotational speed of pump, rpm.

head consisting of the static elevation plus the frictional resistance of the pipeline. Curves relating the frictional resistance to the flow rate describe the pipeline characteristics.

Head loss due to friction is directly proportional to the length of the line plus the equivalent length of all valves and fittings, directly proportional to the square of the flowrate and inversly proportional to the fifth power of the pipe diameter.[2] Thus:

$$H_f = 0.0311 f L Q^2 / D^5$$

The coefficient of pipe friction, f, can be evaluated from nomographs[2] or from well known charts[3] which give it as a function of Reynold's number for varying relative surface roughness.

To get the system characteristic, add the static head and the head loss due to friction and plot the total against flowrate.

Intersection of the system characteristic with the head-capacity curve of the pump locates the work-point of the pump.

To find the head available at any point in the pipeline as a function of the flowrate, subtract the static and friction heads from that developed by the pump. This corrects the head-capacity curve for that point.

Finding an "Equivalent Pump"

If two centrifugal's feed a common pipeline (as in Fig. 1), the working point for each can be found graphically by first plotting a head-capacity curve for an "equivalent pump"—one pump which, in theory, could do the job of both—and then working back to the individual pumps. Fig. 2 illustrates this graphical solution. To solve a similar problem:

- Correct the head-capacity curve of each pump for the conditions at the junction of the branches by subtracting from the developed head the resistance from pump to junction.
- Add the corrected curves to get the head-capacity curve of the "equivalent pump" (H_{12} in Fig. 2).
- Plot the resistance vs. flowrate curve (H) for the rest of the system, and mark its intersection with the curve for the equivalent pump.
- Draw a horizontal line through this point, to intersect the corrected curves of the individual pumps.
- Run a vertical line through each of these intersections. When these cross the uncorrected head-capacity curves, they locate the actual working points of the pumps.

Using It on Complex Lines

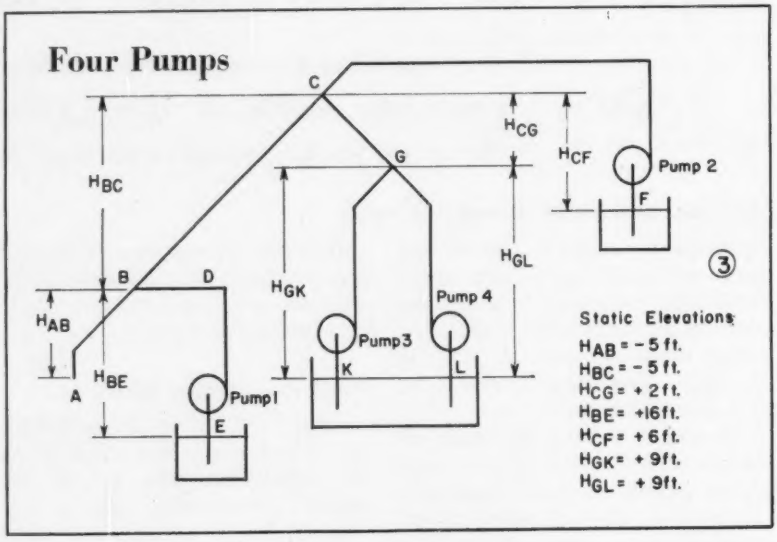
Many awkward piping systems fed by centrifugals can be reduced to the problem just discussed. A typical problem and its solution is shown at right.

By following this method the operating head and capacity of individual centrifugal pumps or the performance of any system of centrifugals under any set of operating conditions can be learned.

Before ending, the author wishes to thank Mr. Andrew Sag for aiding with the numerical evaluation of friction coefficients and Mr. Peter Bojadzijevic for helping prepare the illustrations.

REFERENCES

1. Church, A. H., "Centrifugal Pumps and Blowers," John Wiley and Sons, Inc., N. Y., 1945.
2. Rood, A., *Machine Design*, Sept. 1952, p. 179.
3. Moody, L. F., *Trans. ASME*, Vol. 66, 1944, pp. 671-684.



Try This Typical Pumping Problem

Here's how you can solve a typical problem using this graphical method for rating the performance of centrifugal pumps feeding a common pipeline.

The sketch above shows the main discharge line of an effluent treatment plant. Branchline pumps 1, 2, 3 and 4 feed the main pipeline—a 4-in. cast iron pipe with 10 inspection openings between points A and C. Static elevations of the various sections are also shown.

Table I lists the makeup of each line and its total equivalent length. The graphs in Figs. 4 and 5 show how the frictional resistance of the lines (evaluated from charts[3]) vary with flowrate. These pipe friction curves, added to the appropriate static elevations, form the system characteristics used to correct the head-capacity curves of the pumps.

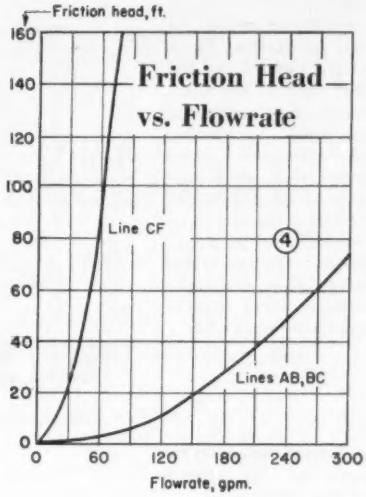
The pumps can work in 11 different combinations. Table II lists the 8 most significant. Case 1, in which all four pumps are operating is solved step-by-step on p. 226.

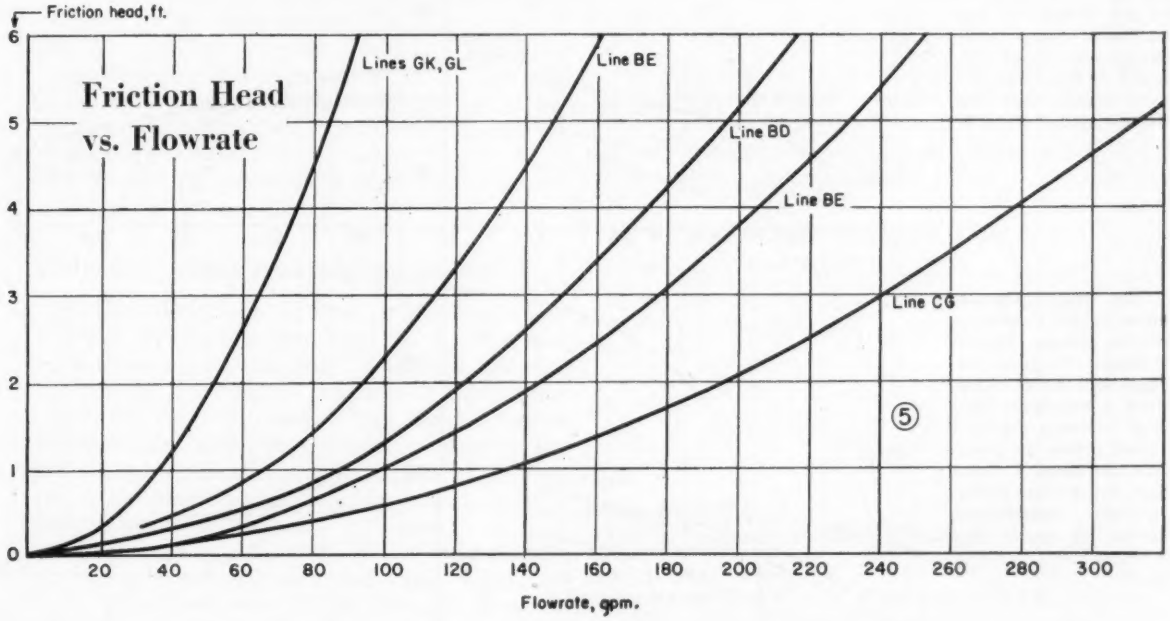
Table II summarizes the results of this and similar calculations for the other cases. Such data aid designers and operators alike.

These are pipeline data for the typical problem (Table I)

Line	Size in.	Material	Length ft.	Valves and Fittings No.	Type	Equivalent Length, Total ft.
AB	4	C. I.	1,000	1	Elbow*	1,022
				5	Inspection openings	
BC	4	C. I.	920	6	Elbows*	1,022
				5	Inspection openings	
				1	Check valve	
				1	Gate valve	
				1	Flowmeter	
CG	4	Blk. Stl.	80	1	Gate valve	90
				1	Elbow*	
BD	4	C. I.	125	1	Check valve	153
				1	Gate valve	
DE	3	Galv. Stl.	15	2	Elbow†	30
				1	Gate valve	
CF	2	Blk. Stl.	1,185	2	Gate valve	1,207
				1	Check valve	
GK and GL	2	Blk. Stl.	13	1	Gate valve	33
				1	Check valve	
				1	Elbow†	

* Long sweep elbows. † Medium sweep elbows.



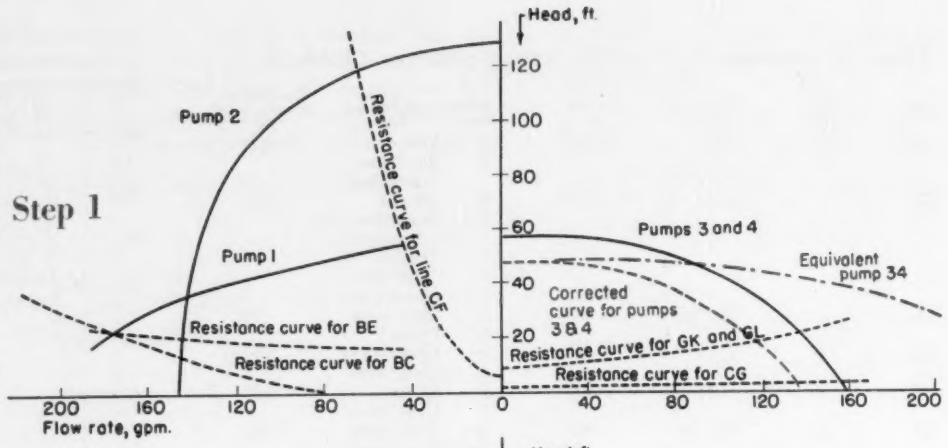


Here are the actual operating points for these pumps under various system conditions (Table II)

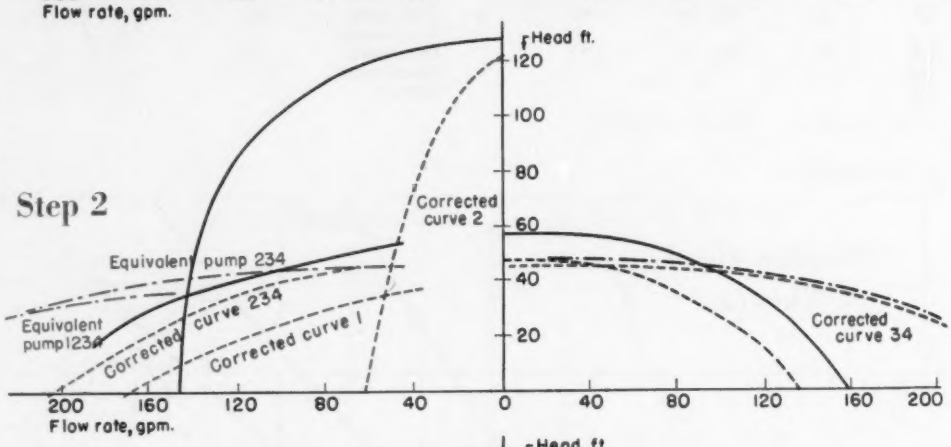
	Pumps Working	Equivalent Pump of System	Pump 1 Head ft.	Pump 1 Flow gpm.	Pump 2 Head ft.	Pump 2 Flow gpm.	Pump 3 Head ft.	Pump 3 Flow gpm.	Pump 4 Head ft.	Pump 4 Flow gpm.	Total Flow gpm.
Case 1.....	1, 2, 3, 4	1234	49	72	121	54	56	41	56	41	208
Case 2.....	1, 2, 3	123	47	84	121	54	53	65	—	—	203
Case 3.....	1, 3	13	44	101	—	—	46	90	—	—	191
Case 4.....	1, 3, 4	134	47	84	—	—	54	60	54	60	204
Case 5.....	3, 4	34	—	—	—	—	49.5	80.5	49.5	80.5	161
Case 6.....	1	1	34	147.5	—	—	—	—	—	—	141.5
Case 7.....	2	2	—	—	118	65	—	—	—	—	65
Case 8.....	3	3	—	—	—	—	35	116.5	—	—	116.5

For a step-by-step look at the graphical solution ➡

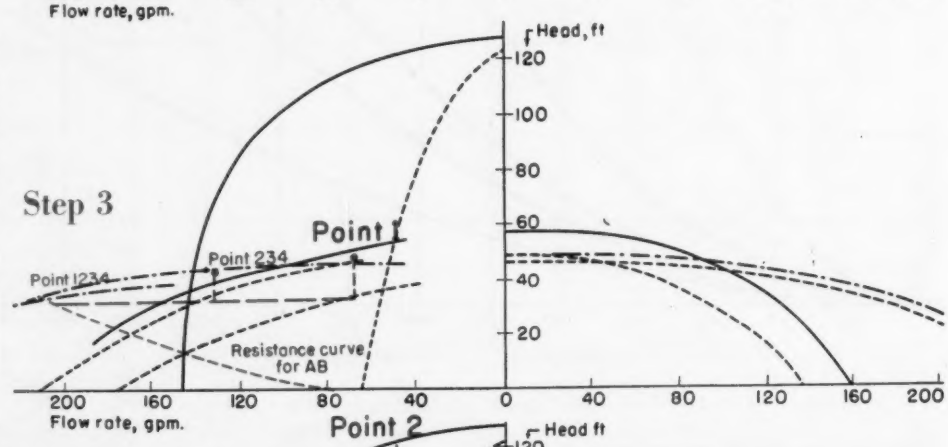
Plot a head-capacity curve for each pump and a resistance curve for each branchline. Since pumps 3 and 4 are the same type in the same service, their curves are the same. Subtracting the resistance curve from the developed head curve of 3 and 4 corrects it to the junction of the pipelines. Adding the corrected curves gives the head-capacity curve for the equivalent pump 34.



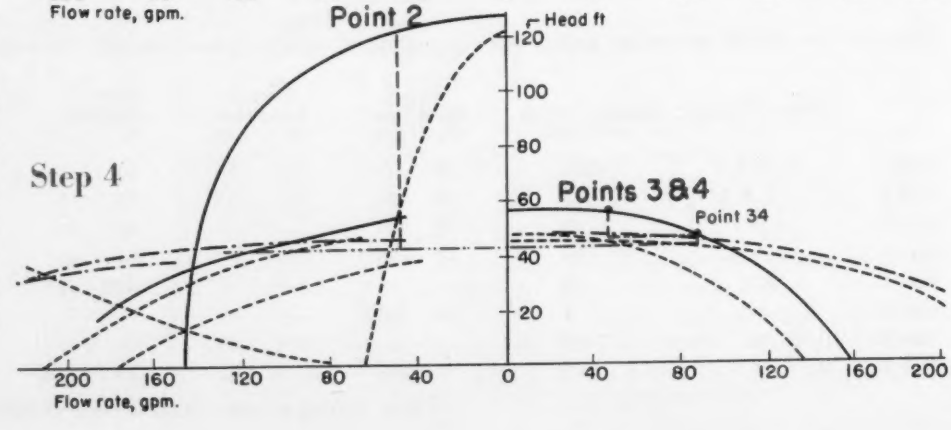
Correct the curves for pump 34 and pump 2 in the same way and add the corrected curves to get a plot for the equivalent pump 234. Repeat with curves 234 and 1 to find an equivalent pump, 1234, for the entire system.



Plot the resistance curve for the remainder of the system. Where it crosses the curve for equivalent pump 1234, draw a horizontal line. This intersects the corrected curves for pump 234 and pump 1. Erect verticals at these points to the uncorrected curves to locate the working points for these pumps.



Draw a horizontal from the working point of 234. This crosses the corrected curves for pumps 2 and 34. Again erect verticals to locate the working points. From the working point of pump 34, repeat the procedure to find working points for pumps 3 and 4. Working points describe the actual operation of the pumps under system conditions.





Chemical Engineering Fundamentals

Interpretation of Kinetic Data—IV

THOMAS E. CORRIGAN, Research Engineer, Olin Mathieson Chemical Corp., Brandenburg, Ky.

In order to show you how to interpret experimental kinetic data, we have worked out two sample problems (*Chem. Eng.*, June 1955, p. 253). This month we'll conclude with two additional problems.

We still assume that we have collected data from a fixed-bed prepilot plant reactor. The reaction is catalytic gas phase and reversible. Feed is a mixture of A and B; product is a mixture of R and S. The value of the equilibrium constant for the reaction at 1,000 F. has been calculated as 10.0. Further, all the data are isothermal at 1,000 F.

You'll find the experimental values for 72 runs on p. 255 of the June installment.

Problem 3—Most Probable Mechanism

Problem—Determine the most probable mechanism by which the reaction may occur. Is it adsorption, surface reaction or desorption? Select the best rate equation and determine the constants of the equation.

Solution—We will consider three broad categories for mechanisms: adsorption controlling, surface-reaction controlling and desorption controlling. Any of these can be the controlling step in either a single-site or a dual-site over-all mechanism.

As a preliminary trial, we'll use the initial rates to distinguish between the basic mechanisms, if possible. These initial rates are calculated for sets of experimental data by the methods illustrated last month in Problem 2. They are:

Total Pressure, π	Feed Ratio, A/B	r_o
1	1 to 1	5.07
1	1 to 4	5.0
4	1 to 1	5.05
4	1 to 4	5.02
10	1 to 1	5.0
10	1 to 4	5.0

From this table of calculated values, we see that the initial rate has the same value for all conditions. It is independent of both pressure and mole ratio. Our conclusion: the mechanism is one in which the desorption step controls the rate.

Is the Mechanism Single- or Dual-Site?

The most probable mechanisms that could be involved are: dual site, dual site modified or single site. For a dual-site mechanism we have

$$A + l \rightleftarrows Al \quad (1)$$

$$B + l \rightleftarrows Bl \quad (2)$$

$$Al + Bl \rightleftarrows Rl + Sl \quad (3)$$

$$Rl \rightleftarrows R + l \quad (4)$$

$$Sl \rightleftarrows S + l \quad (5)$$

with either step (4) or (5) controlling. The rate equation corresponding to this mechanism is:

$$r = k[p_A p_B - (p_R p_S/K)]/ p_S[1 + K_A p_A + K_B p_B + K_S p_S + (K_R p_A p_B/p_S)]$$

For a dual-site modified mechanism we would have these steps:

$$A + l \rightleftarrows Al \quad (1)$$

$$B + l \rightleftarrows Bl \quad (2)$$

$$Al + Bl \rightleftarrows Rl + S + l \quad (3)$$

$$Rl \rightleftarrows R + l \quad (4)$$

With step (4) controlling the corresponding rate equation is

$$r = k(p_A p_B - (p_R p_S/K)/ p_S[1 + K_A p_A + K_B p_B + (K_R p_A p_B/p_S)]$$

The third possible mechanism is the single-site mechanism.

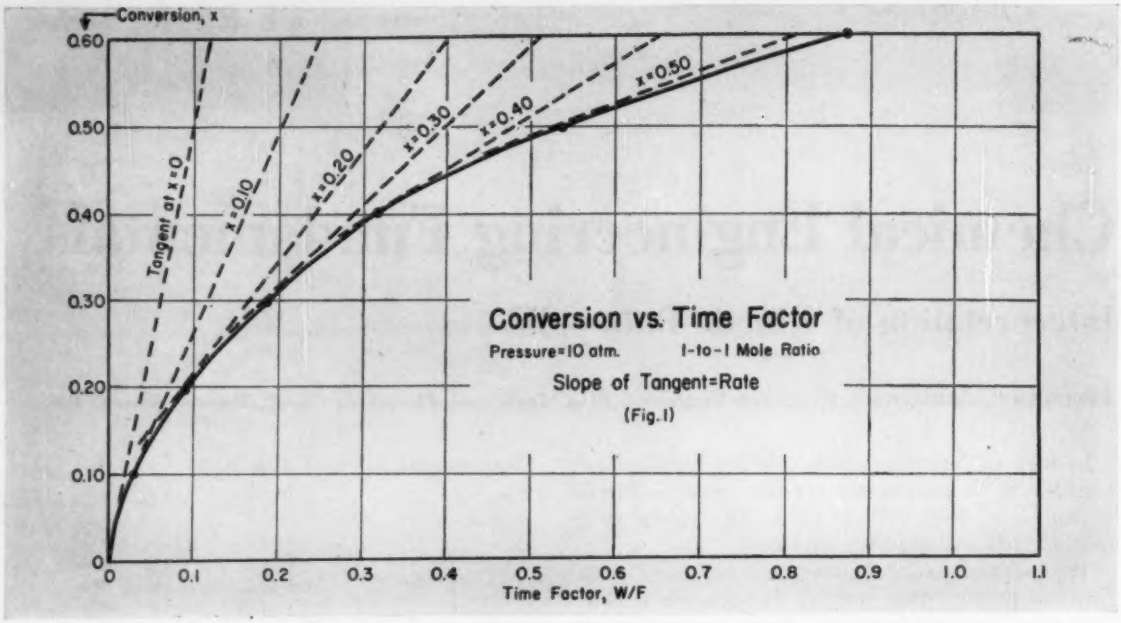
$$A + l \rightleftarrows Al \quad (1)$$

$$Al + B \rightleftarrows Rl + S \quad (2)$$

$$Rl \rightleftarrows R + l \quad (3)$$

Nomenclature (Consistent units)

a, b, a', b'	Empirical constants
c, d, e	Empirical constants
A, B	Reactants
F	Feed rate
k	Rate constant
K	Equilibrium constant
l	An active center
p_A	Partial pressure of adsorbent gas
r	Reaction rate
r_o	Initial reaction rate
R, S	Products
W	Mass of catalyst
x	Degree of conversion
π	Total pressure



With step (3) controlling, the rate equation is

$$r = k[p_A p_B - (p_R p_S/K)]/p_S[1 + K_A p_A + (K_R p_A p_B/p_S)]$$

In all three cases the initial rate is the same.

$$r_o = k(p_A p_B/p_S)/K_R(p_A p_B/p_S) = k/K_R$$

Therefore, $k/K_R = 5.0$

The difference between the three possible rate equations is that the single-site equation is the simplest; the modified dual-site equation has an added $K_B p_B$ term in the denominator; the dual-site equation has an added $K_B p_B$ term plus an added $K_S p_S$ term.

For simplification, let's put the equations in the following form:

$$r = [p_A p_B - (p_R p_S/K)]/p_S[a + bp_A + c(p_A p_B/p_S)]$$

where $a = 1/k$; $b = K_A/k$; and $c = K_R/k$.

$$[1/p_S][p_A p_B - (p_R p_S/K)]/r = a + bp_A + c(p_A p_B/p_S)$$

But we know the value of c; $c = K_R/k = 0.2$. Therefore, rearranging so that only the unknowns a and b appear on the right-hand side of the equation,

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2(p_A p_B/p_S) = a + bp_A$$

for the single-site mechanism.

Similarly for the dual-site modified and dual-site mechanisms, we have

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2(p_A p_B/p_S) = a + bp_A + bp_B$$

and

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2(p_A p_B/p_S) = a + bp_A + bp_B + cp_S$$

In the single-site equation a plot of the term

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2(p_A p_B/p_S)$$

against p_A would be a straight line. The slope of the line would give the value of b and the intercept would give the value of a.

We'll try this, but first we'll have to determine values of r. To do this we'll take slopes of tangents to the x vs. W/F curve . Fig. 1 shows the plot of x vs. W/F for the case of 10 atm. and 1-to-1 mole ratio with the tangents drawn in. The figure gives us these data:

x	W/F	r (From Fig. 1)	$1/r$
0	0	5.0	0.200
0.1	0.032	2.25	0.434
0.2	0.091	1.26	0.794
0.3	0.184	0.92	1.087
0.4	0.319	0.62	1.61
0.5	0.533	0.373	2.69
0.6	0.883	0.233	4.28

From the values in the table above we can calculate these additional values below:

$1/r$	p_A	p_B	p_R	p_S	$p_A p_B - (p_R p_S/K)$	$p_A p_B/p_S$
0.200	5.00	5.00	0	0	0.25	....
0.434	4.50	4.50	0.50	0.50	20.18	40.4
0.794	4.00	4.00	1.00	1.00	15.90	16.0
1.087	3.50	3.50	1.50	1.50	11.98	8.13
1.610	3.00	3.00	2.00	2.00	8.60	4.50
2.69	2.50	2.50	2.00	2.00	5.63	2.50
4.28	2.00	2.00	3.00	3.00	3.10	1.33

x	$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r}$	$\frac{[1/p_S][p_A p_B - p_R p_S/K]}{r} - 0.2\frac{p_A p_B}{p_S}$
0	.....	....
0.1	17.50	9.4
0.2	12.62	9.42
0.3	8.65	7.03
0.4	6.93	6.03
0.5	6.10	5.60
0.6	4.44	4.17

These data are plotted in Fig. 2 and we see that $a = 0.2$, $a = 1/k$; $b = 2.0$, $b = K_A/k$.

Thus, if the single-site mechanism is a correct assumption, we now have the values of the constants in the rate equation.

However, the dual-site or the modified dual-site mechanism may also hold since either one would also give a straight line if plotted in the same manner. This is because the terms, p_A, p_B, p_R and p_S are not independent variables. They are related by the stoichiometry of the reaction.

Let's determine the relations for each set of experimental conditions. This will simplify our rate equations. For the first case the pressure is 1.0 atm. and the mole ratio is 1 to 1.

$$p_A + p_B + p_R + p_S = 1.0$$

But $p_A = p_B$ and $p_R = p_S$. Therefore,

$$2p_A + 2p_S = 1.0 \qquad p_A + p_S = 0.5$$

$$p_S = 0.5 - p_A$$

We'll substitute these values into our single-site rate equation.

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2(p_A p_B/p_S)$$

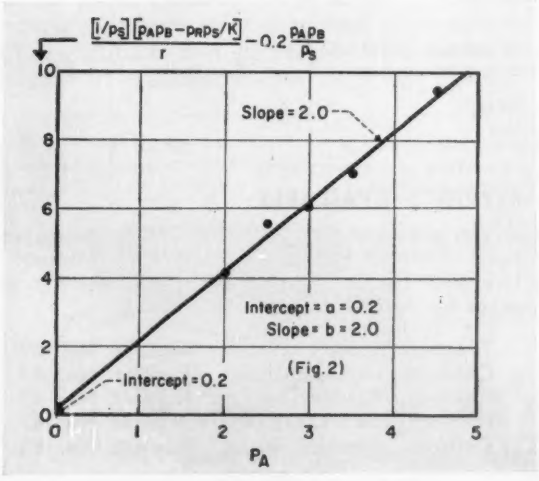
$$= a + bp_A + dp_A + e(0.5 - p_A)$$
$$= (a + 0.5e) + (b + d - e)p_A$$
$$= a' + b'p_A$$

Where $a' = (a + 0.5e)$; and $b' = (b + d - e)$. Likewise, the equation for a modified dual-site mechanism becomes

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2\frac{p_A p_B}{p_S} = a' + b'p_A$$

Where $a' = a$; and $b' = b + d$. Similar relations are calculated for all the remaining experimental conditions and are summarized below:

Pressure, atm.	Mole Ratio	Dual-site a'	Dual-site b'	Modified Dual-site a'	Modified Dual-site b'
1.0	1 to 1	$a+0.5e$	$b+d-e$	a	$b+d$
4.0	1 to 1	$a+2e$	$b+d-e$	a	$b+d$
10.0	1 to 1	$a+5e$	$b+d-e$	a	$b+d$



If we prepare plots similar to Fig. 2 for the three cases above, we find that in all cases the slope is 2.0 and the intercept is 0.2. Therefore, if a' is independent of pressure, e must be equal to zero and the dual-site mechanism is eliminated as a possibility.

But Is B Adsorbed?

In order to distinguish between the modified dual-site equation and the single-site rate equation we will have to make use of data that have been taken with varying mole ratio.

Consider the stoichiometric relations for the case of 1-to-4 mole ratio and 10 atm. Here $p_B = p_S$.

$$p_A + p_B + p_R + p_S = 10$$
$$p_A = \pi(1 - x)/2 = 5(1 - x)$$
$$p_B = [3 + (1 - x)]\pi/2 = 5(3 + 1 - x)$$
$$= 5(3) + 5(1 - x)$$
$$p_B = p_A + 15$$

Then, the modified dual-site equation becomes

$$\frac{[1/p_S][p_A p_B - (p_R p_S/K)]}{r} - 0.2\frac{p_A p_B}{p_S} = a + bp_A + d(p_A - 15)$$
$$= (a + 15d) + bp_A$$

Therefore, $a' = a + 15d$. Now, evaluate a' at 4.0 atm. and 1-to-1 mole ratio.

$$p_A + p_B + p_R + p_S = 4.0$$
$$p_R = p_S \qquad p_A = 0.5\pi(1 - x)$$
$$p_B = 0.5\pi[3 + (1 - x)] = 0.5\pi(3) + 0.5\pi(1 - x)$$
$$p_B = 6 + p_A$$

Thus, $a' = a + 6d$. Plots similar to Fig. 2 are made at the three pressures at the 1-to-4 mole ratio and in all cases $a = 0.2$. This means that d would have to be equal to zero and B is not adsorbed.

This leads us to the conclusion that the single-site equation is the only one which fits the data and the mechanism is a single-site mechanism. The steps are

$$A + 1 \rightleftarrows A1 \qquad (1)$$
$$A1 + B \rightleftarrows R1 + S \qquad (2)$$
$$R1 \rightleftarrows R + 1 \qquad (3)$$

and the rate equation is

$$r = \frac{5[p_A p_B - (p_R p_S/10)]}{p_S[1 + 2p_A + 1.0(p_A p_B/p_S)]}$$

Problem 4—Calculated vs. Experimental

Problem—Check the rate equation derived in problem 3 against the original data by plotting x vs. W/F and comparing the calculated curve against the original data.

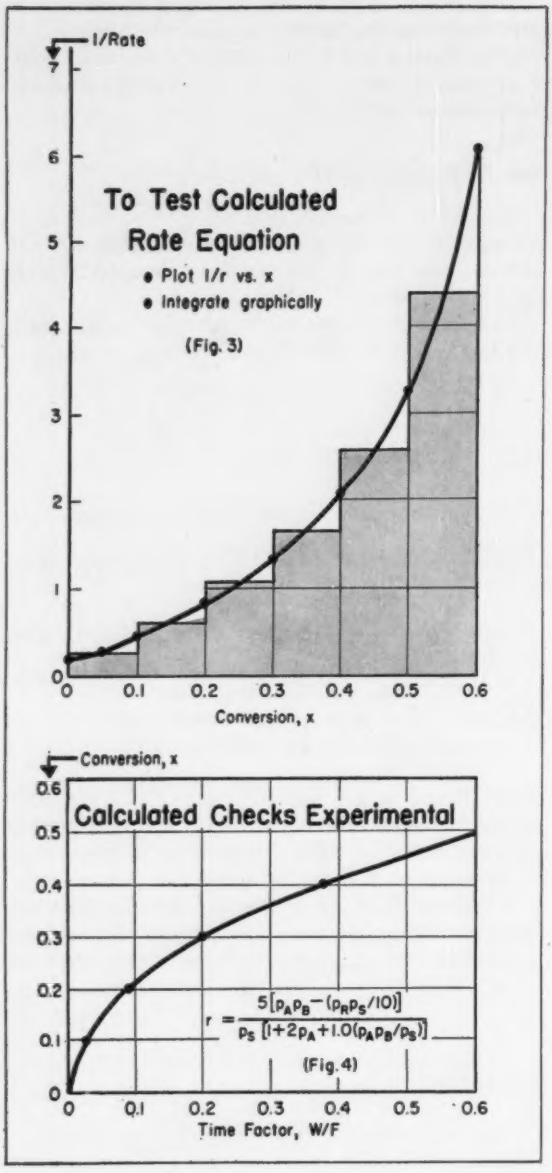
Solution—We'll use the fundamental differential equation

$$W/F = \int_0^x dx/r$$

In the particular case that we have been analyzing

$$\frac{W}{F} = \int_0^x \frac{dx}{5[p_A p_B - (p_R p_S/K)]/p_S[1 + 2p_A + 1.0(p_A p_B/p_S)]}$$

The equation can be integrated quite conveniently



since r is a function of conversion. Let us check the equation for the case of 1 atm. pressure and a 1-to-1 mole ratio.

The tables below show the calculations involved in the plotting of this equation. To integrate, plot $1/r$ against x and determine the area under the curve.

x	$1-x$	p_A, p_B	p_R, p_S	$p_A p_B - (p_R p_S/10)$
0	0	0.50	0	0.25
0.05	0.95	0.475	0.025	0.225
0.1	0.9	0.45	0.05	0.202
0.2	0.8	0.40	0.10	0.159
0.3	0.7	0.35	0.15	0.120
0.4	0.6	0.30	0.20	0.086
0.5	0.5	0.25	0.25	0.0568
0.6	0.4	0.20	0.30	0.031
0.7	0.3	0.15	0.35	0.0108

x	$p_S[1 + 10p_A + (p_A p_B/p_S)]$	r	$1/r$
0	.....	5.0	0.20
0.05	0.335	3.36	0.298
0.1	0.478	2.12	0.471
0.2	0.660	1.20	0.833
0.3	0.80	0.75	1.335
0.4	0.890	0.484	2.07
0.5	0.938	0.304	3.29
0.6	0.940	0.165	6.06
0.7	0.898	0.060	16.7

The next step is to plot $1/r$ vs. x and take the area under the curve from zero to each succeeding value of x. The total area under the curve up to any given value of x is the W/F value which corresponds to the particular x value.

The plot of $1/r$ vs. W/F is shown in Fig. 3 and the results are tabulated below:

x	Total Area, (W/F)
0	0
0.1	0.0325
0.2	0.0929
0.3	0.2029
0.4	0.3739
0.5	0.6289
0.6	1.609

These data are plotted in Fig. 4. You'll note that this curve coincides with a plot of the experimental data (see *Chem. Eng.*, June 1955, p. 254).

The problems illustrated in these last two installments were hypothetical and were for the purpose of illustration only. Actually a mechanism where the desorption step controls is more difficult to solve because the initial rate data cannot be used to evaluate more than one of the constants.

The author wishes to acknowledge the assistance of Mr. Charles U. Guy, Research Engineer, Olin Mathieson Chemical Corp., Brandenburg, Ky., in the calculations involved in setting up and solving the problems in the June and July installments.

What's Ahead?

We've covered in this series two important phases of kinetics: how to obtain kinetic data, and how to interpret it. Our next job is to show how you can use kinetics in the practical chemical engineering problem of reactor design. So, starting next month, a new CE Refresher series on the Fundamentals of Reactor Design.

REPRINTS AVAILABLE

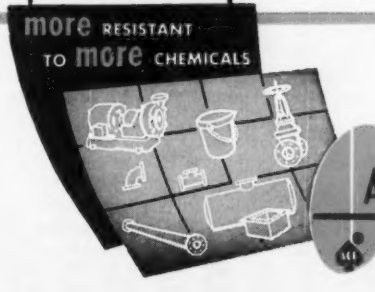
You can now get reprints of the first five sections of the CE Refresher Series. Price 50¢ each. Use your Reader Service postcards inside back cover for fastest delivery.

Thermodynamics . . . . . Reprint No. 42
Compression-Expansion . . Reprint No. 45
Chemical Equilibrium . . Reprint No. 49
Homogeneous Kinetics . . . Reprint No. 57
Catalytic Kinetics . . . . . Reprint No. 61

85 to 100% of your corrosion-resistant piping needs now available from 1 source

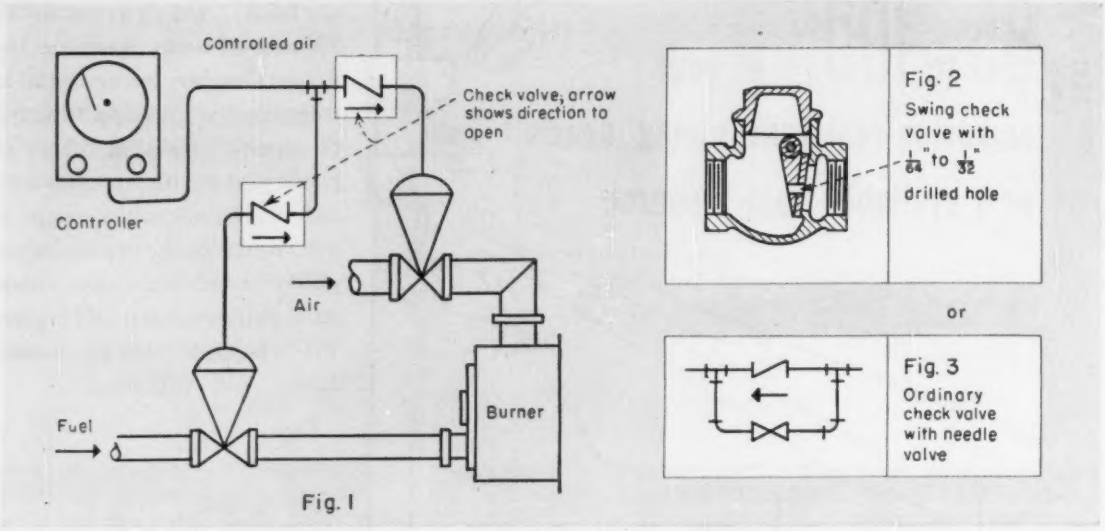
There is no single material for chemical piping that can handle all corrosive fluids . . . and do it economically. To meet all needs, American Hard Rubber Company has developed and refined no less than eight basic types of corrosion-resistant rubber and plastic pipe and tubing...plus a wide variety of fittings, valves, pumps, and other equipment for assembling completely protected chemical systems. ACE distributors and field engineers will be happy to make recommendations . . . call ACE first.

WHICH PIPE SHOULD YOU USE...		WHERE...WHEN?
ACE-ITE Threaded Pipe ½" to 6"	General purpose rubber-plastic blend. Tough, impact resistant. Odorless, tasteless. Economical.	Handles most common chemicals to 170°F. except a few strong acids and certain organic solvents.
RUBBER-LINED STEEL Flanged Pipe 1½" to 24" and up	Strength and pressures of steel plus resistance of hard rubber. Soft rubber interlayer aids shock resistance.	Finest resistance to alkalis, most inorganic acids, many organic acids, all salts. Ideal for bleaches.
ACE TEMPRON Threaded Pipe 1" to 8"	For hot corrosives to 260-275 deg. F. Rigidity and resistance better than previous nitriles.	Best anywhere for *hot* inorganic chemicals, acids. Also unusually wide variety of organics at room temp.
ACE RIVICLOR Threaded Pipe ½" to 4"	Rigid plastic, special PVC. Outstanding aging characteristics. Good cold impact strength.	Lies between Saran and Parian. Not affected by most inorganic acids and alkalis. Good for many organics also.
ACE PARIAN Threaded Pipe ½" to 2"	Odorless, tasteless, rigid polyethylene. Not strongest plastic, but best for sub-zero uses.	Best resistance of any plastic at room temp. except to acetic acid. Good for alkalis, acids, many organics.
ACE HARD RUBBER Threaded Pipe ¼" to 8" Flanged Pipe 1½" to 8"	The oldest, still tops. Widest range of fittings of any rigid non-metallic pipe.	Extreme resistance to alkalis, most inorganic acids, many organic acids, all salts. Ideal for chlorine, fluorine.
ACE SARAN Threaded Pipe ½" to 4" Tubing ⅛" to 1¼"	Odorless, tasteless, general-purpose rigid pipe and semi-flexible tubing. High pressures.	Excellent . . . not affected by most inorganic acids and alkalis. High resistance to most organics.
ACE-FLEX Flexible Tubing ⅛" to 1¼"	General-purpose transparent flexible tubing. Non-toxic, odorless, tasteless. Can steam-sterilize.	Very good resistance to most inorganic acids and alkalis. Resists many organics at room temperature.



ACE® rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.



★ **Winner of April Contest**

Automatic Delay for Burner Control

Joseph R. Wilson

Mechanical Engineer, Stratford Engineering Corp., Kansas City, Mo.

Automatic controls frequently installed on small boilers using forced draft are seldom designed to provide delay in the fuel-air ratio control. However, when the load is changed, it is desirable to increase the air flow before an increase in fuel flow rate. Similarly, it is desirable to decrease the air flow after a decrease has been made in the fuel flow rate.

To provide delays of this sort it is usually necessary to employ more complicated burner controls, or special delay circuits. To avoid this, the general practice is to increase the air ratio to a point where load changes will not produce an undesirably low air-fuel mixture. However, this practice means poor economy, owing to the large amount of excess air which it supplies when an excess is not needed, that is, during steady operating conditions.

When the controller is pneumatic, there is a very simple way of building time-delay features into the instrument air piping, using only materials which the pipefitters' storeroom will easily provide. Very briefly, the idea is to install check valves and controlled leaks in the instrument air lines running from the controller to the fuel valve and the air valve. These are installed so that a call for more fuel by the controller will immediately increase the air flow, but will delay the opening of the fuel valve; while a call for less fuel by the controller will immediately decrease the fuel flow, but will delay the closing of the control valve in the air supply line.

It is likely that the same sort of delay can also be applied usefully

---

★ **Winner of May Contest:**

Continuous Sampler for Gases at High Pressure Works at Controlled Rate.

A prize of $50 in cash is going to E. R. Hawley and Ernest Solomon, of M. W. Kellogg Co.'s petroleum and chemical research department, Jersey City, N. J. Their article, to appear in August shows how to build and operate the sampler for continuously, and at a known rate, withdrawing and storing gas samples at high pressure.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

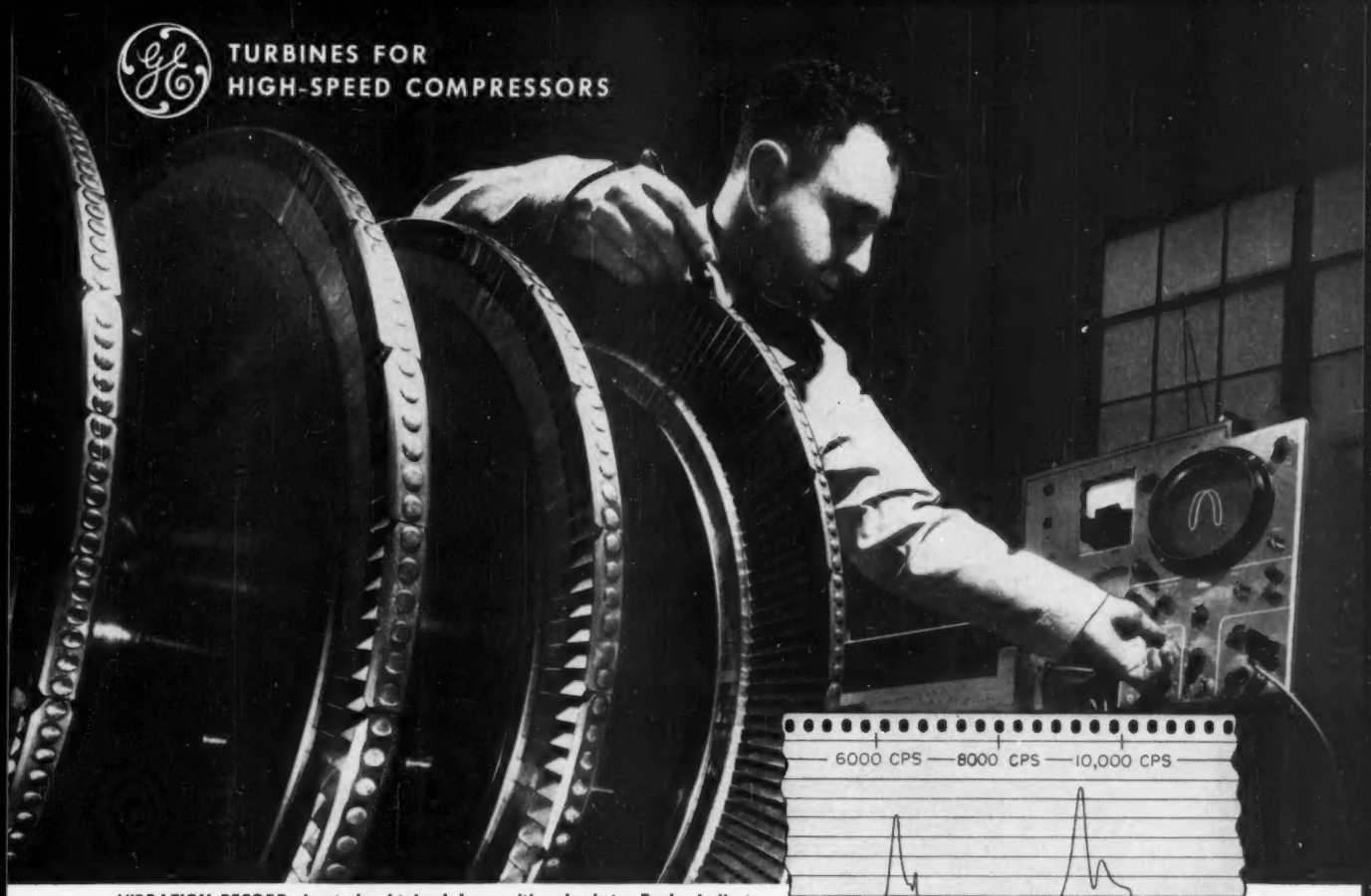
Each month's winner will be announced in the issue of the second following month, and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article which will then be awarded an addition $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at regular space rates ($10 minimum).

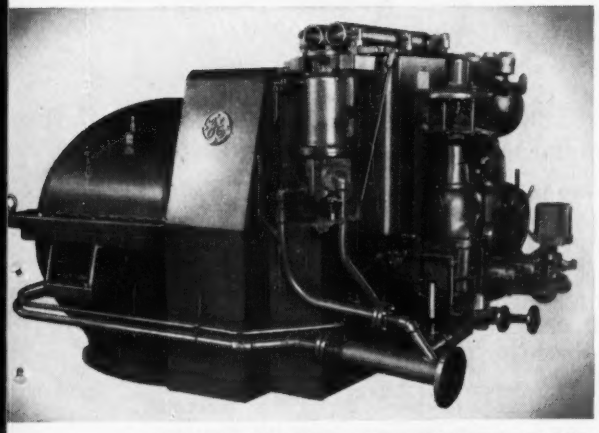
Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

TURBINES FOR
HIGH-SPEED COMPRESSORS



VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.

How G-E Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

HERE'S HOW General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

VIBRATION TESTING is one of many features that add to the reliability of G-E high-speed turbines. For more information, contact your nearest G-E Apparatus Sales Office or write General Electric Company, Schenectady 5, N. Y. 241-2

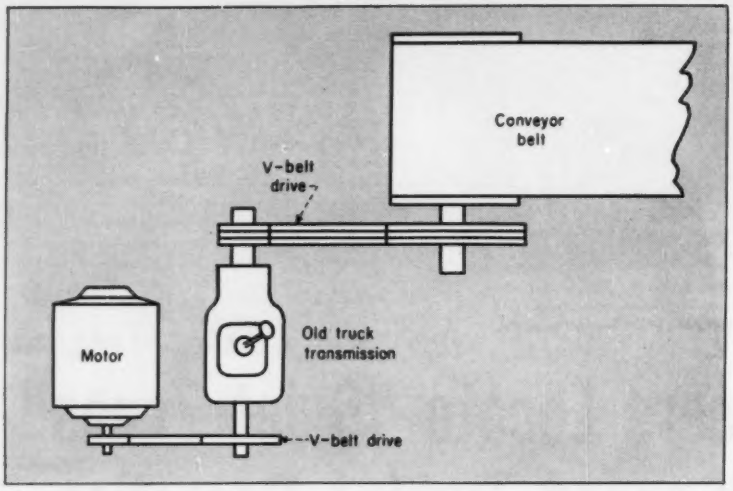
Progress Is Our Most Important Product

GENERAL ELECTRIC

to various other control problems as well.

Fig. 1 shows the set-up, with checks installed in the instrument air piping from the controller to the air and fuel valves. The details of Figs. 2 and 3 show two ways of producing the desired delay action. The simpler method, Fig. 2, consists merely in drilling a $\frac{1}{64}$- to $\frac{1}{32}$-in. hole through the flapper of an ordinary swing-check valve. When this is installed for a delayed increase and rapid decrease of the diaphragm-valve pressure and opening (i.e., in the fuel control valve line), it is oriented to open toward the controller. When it is installed to provide a rapid increase and a delayed decrease of the diaphragm valve pressure and opening (i.e., in the air control valve line), it is oriented to open away from the controller and toward the control valve. Thus, in the first case there will be only a slow increase in diaphragm pressure, by leakage through the flapper orifice, while pressure can decrease immediately by opening of the flapper. In the second case the reverse will be true.

Fig. 3 shows an obvious improvement in which the leak through the flapper is replaced by a bypass around the check, containing a small needle valve. This method operates the same as Fig. 2, but has the advantage of permitting the leak rate and hence the delay time to be regulated to give the best possible operation.



Truck Transmission Drives a Conveyor

Carl L. Murray

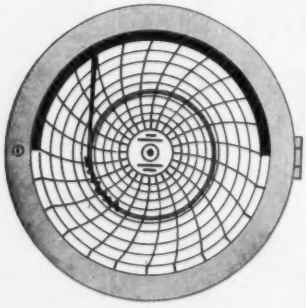
Associate Engineer, Phillips Petroleum Co., Atomic Energy Div., Idaho Falls, Idaho.

In an emergency, or for a low-investment conveyor belt drive, one can use a junk transmission from a truck. These old transmissions can be picked up for $10-$20 from an auto salvage yard and make good gear drives for conveyor belts. This is especially true if it is necessary to vary the belt speed to fit different process rates. Because no clutch arrangement is used, it will be necessary to stop the motor to change speeds, but there are obvious advantages to eliminating the clutch mechanism.

Your own machine shop can easily adapt the transmission to provide this simple variable-speed drive as shown in the sketch above.

If the transmission is of the helical gear type, it will be necessary to equip the drive shaft with a tapered roller bearing to absorb the thrust that is normally handled by the truck engine rear main bearing. The entire transmission is kept sealed and lubricated the same as when in service in the truck.

One word of caution. When buying a unit of this type be sure to discuss it thoroughly with the salvage man. He will know the more popular makes for which replacement parts are most likely to be available. He will naturally charge you more for one of these units, but it may save you some grief in the long run. Don't, for instance, purchase a 1925 Reo transmission because it is cheaper, if you find that was the only year that particular style was manufactured. You may save a lot of trouble later by investing another $10.

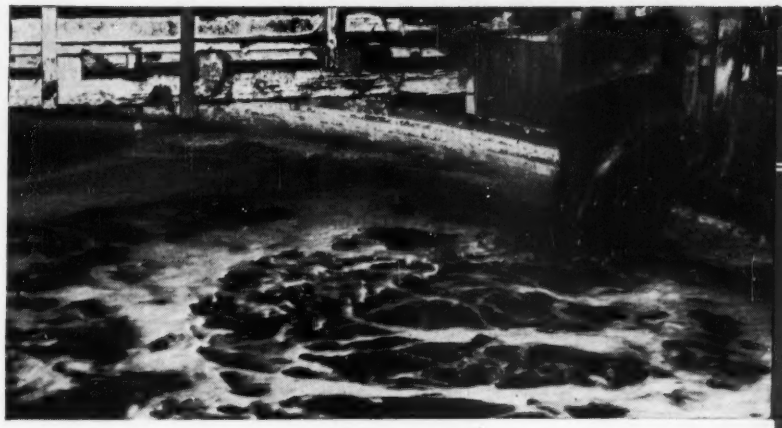


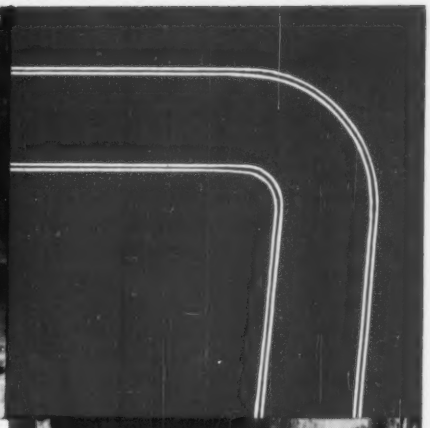
Mark Your Charts for Normal Conditions

Thomas Garcia B.

Chief Chemist, Lab TUGN, Petroleos Mexicanos, Poza Rica, Ver., Mexico.

In most continuous processes the recorder charts for pressures, temperatures, flows, and the like, will average out quite close to a line which can be considered normal operating conditions. However, operators — especially new ones — may forget what the nor-







WILFLEY ACID PUMPS

Proven Efficiency

.....handling Acids, Corrosives, Hot Liquids and other solutions

The record of Wilfley Acid Pumps is written in hundreds of modern chemical plants throughout the world where Wilfleys are a vital factor in reducing costs and increasing production.

Absolute dependability under the pressure of round-the-clock schedules has established Wilfley Acid Pumps as the leader in this field. Available with pumping parts of machinable alloys as well as plastic to meet all requirements. Individual engineering on every application.

A Wilfley Acid Pump handling a Zinc Electrolyte

Write or wire for complete details.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

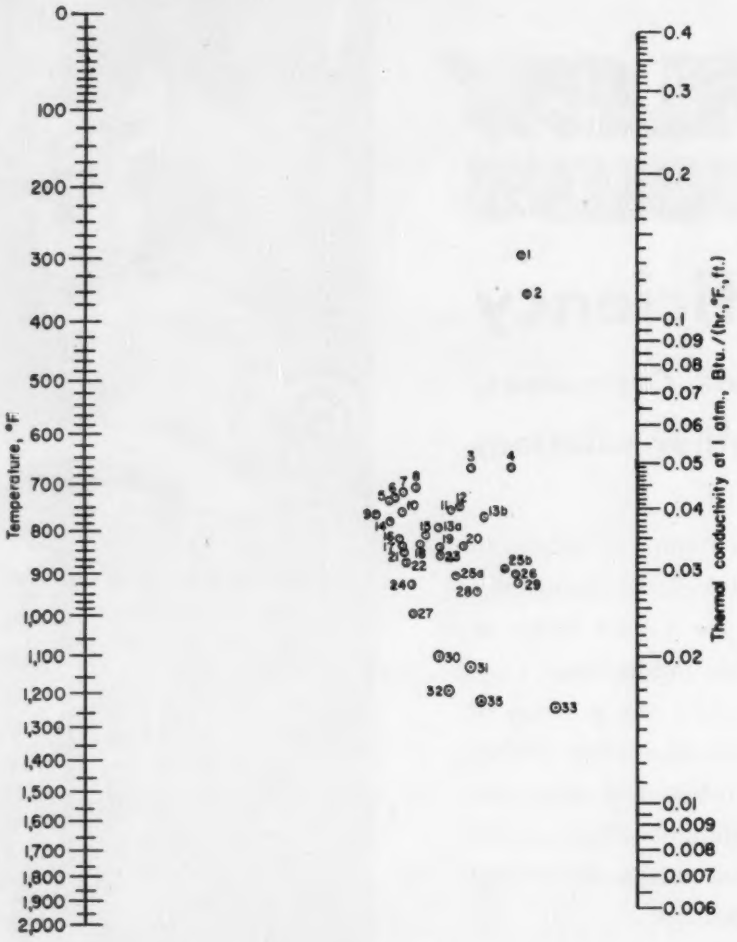
A. R. WILFLEY and SONS, INC., DENVER, COLORADO, U. S. A.

New York Office: 1775 Broadway, New York City

mal conditions are. This is not too unlikely for experienced men when "there are too many charts."

A very simple way to help the operators—and everyone else as well—is to mark the charts with "normal" lines in a distinguishing color before they are put on the recorders. Similarly, indicating gages for pressure, liquid level, and the like, can be marked with a dab of paint or a strip of adhesive tape on the glass covering the dial.

The sketch shows how the idea can be applied to round charts. On strip charts it will probably be more convenient to mark the glass or the scale above the chart. Sometimes, instead of "normal" the mark may be used to show limits.



Thermal Conductivity Chart for Gases

Om P. Kharbanda

Research Dept., Simon-Carves Ltd., Stockport, England.

Many chemical engineering calculations require a knowledge of the thermal conductivity of common gases and vapors at 1 atm. and varying temperatures. Existing data in the literature consist of tabulations[1, 2, 3] of thermal conductivity at different temperatures. Since their interpolation and extrapolation are both tedious and time-consuming, the nomograph above was constructed to aid the busy engineer in finding the desired data at temperatures between 0 and 2,000° F. with but a single setting.

Identification of Points on Chart

No.	Gas
16	Acetone
8	Acetylene
26	Air, O_2, N_2
11	Ammonia
28	Argon
9	Benzene
6	*n*- and iso-butane
25*a*	Carbon dioxide, 0-1,000°F.
25*b*	Carbon dioxide, 1,000-2,000°F.
29	Carbon monoxide
32	Carbon tetrachloride
35	Chlorine
30	Chloroform
24	Dichlorodifluoro methane
12	Ethane
17	Ethyl acetate
23	Ethyl alcohol
21	Ethyl chloride
10	Ethyl ether
13*a*	Ethylene, 0-1,000°F.
13*b*	Ethylene, 1,000-2,000°F.
33	*n*-heptane
18	*n*-hexane
2	Helium
14	Hexene
1	Hydrogen
3	Methane
15	Methyl alcohol
22	Methyl chloride
27	Methylene chloride
4	Neon
19	Nitrous oxide
5	*n*- and iso-pentane
7	Propane
31	Sulfur dioxide

The data used in constructing the chart came from the three listed references. For A, Ne and He at 32-212° F. they came from Ref. (1). For air, H_2, N_2, O_2, CO, CO_2, CH_4, C_2H_4 and C_2H_6 at 0-2,000° F. they came from Ref. (2). All others, at varying temperatures from 32 to 572° F., came from Ref. (3).

For chlorine Perry's Handbook[3] lists the thermal conductivity at only one temperature. Values at other temperatures were calculated by assuming that the Prandtl Number $c\mu/k$ does not change with temperature.

Other gases not included on this chart can easily be added, provided that the values of thermal conductivity at two temperatures are known. Simply draw straight lines connecting the two known values and mark the intersection as the point for that gas.

REFERENCES

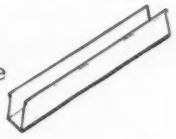
1. D'Ans, J. and E. Lax, "Taschenbuch für Chemiker Physiker," Springer, Berlin, (1943).
2. Institute of Fuel, "Waste Heat Recovery from Industrial Furnaces," Chapman & Hall, London (1948).
3. Perry, J. H., "Chemical Engineers' Handbook," McGraw-Hill, New York (1950).

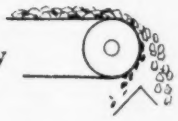
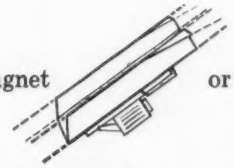
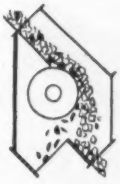
Product purification has many magnetic answers

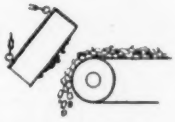
You want a clean pure product  free from dangerous tramp iron  You need a magnetic separator  to remove this iron contamination.

But what kind of magnet? First you contact a Stearns Magnetic engineer 

He checks your product; granular or powder  chunks 

liquid  ; the kind of tramp iron, such as mixed scrap  or tiny iron particles  ; the kind of conveyor like belt  chute 

or pipe  Based on these and many other factors, he might recommend a magnetic pulley  or a spout magnet  or a magnetic drum 

or suspended magnet  or multiple stage cross belt  ;

or if the product is liquid, a magnetic filter  or a pipe trap magnet 

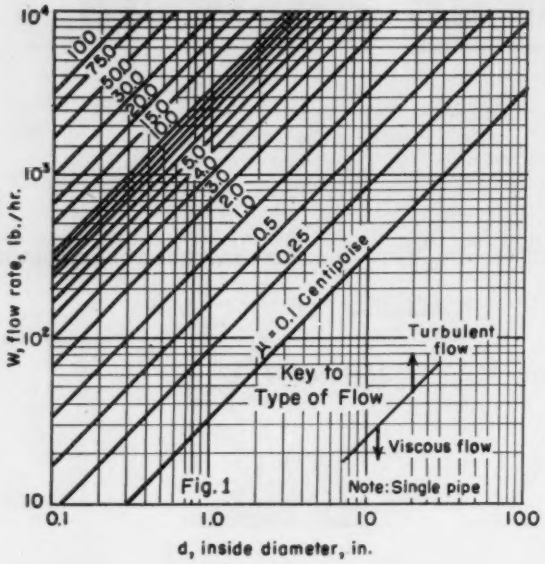
Stearns Magnetic, Inc. builds all these plus other highly specialized magnetic separators, electro or permanent, either in standard models or custom-built to your exact needs. We will be happy to send you literature on any of the separators mentioned above — or answer specific questions on tramp iron removal or product purification. Complete laboratory facilities available for testing materials. Write, wire or call us or see your Stearns Representative.

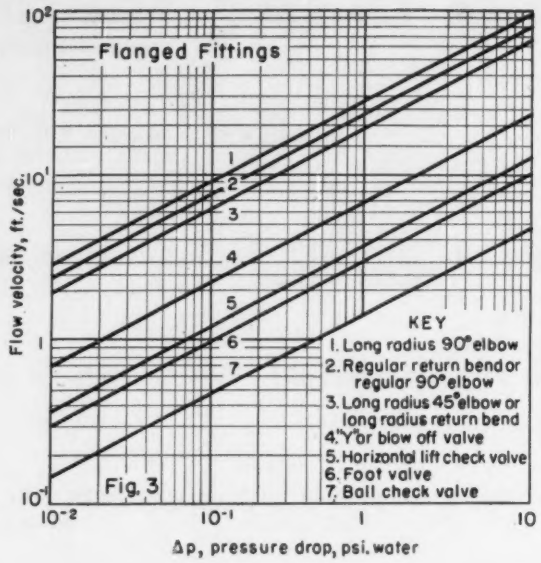
1127

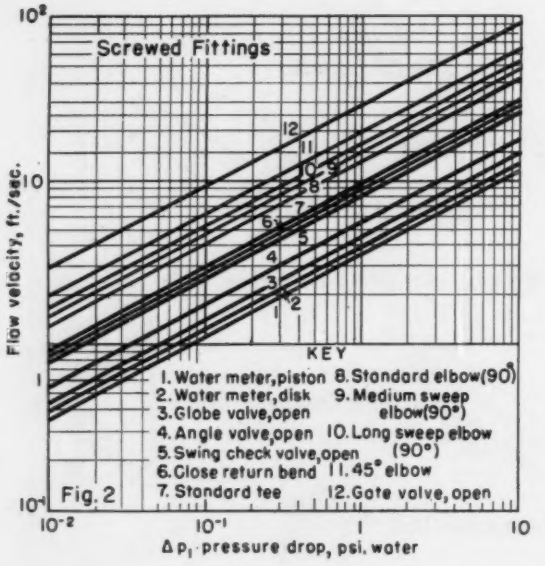
MAGNETIC EQUIPMENT FOR ALL INDUSTRY

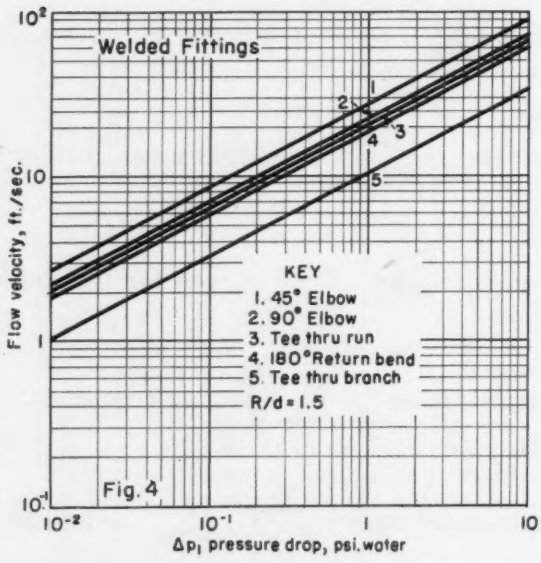
STEARNS MAGNETS

STEARNS MAGNETIC, INC., 629 S. 28th St., Milwaukee 46, Wis.









Aids for Pressure Drop Calculations

J. R. LaPointe and G. G. Nahay

Pittsburgh Coke & Chemical Co., Neville Is., Pittsburgh, Pa.

The charts above, plus the table on the next page, will help in reducing the design engineer's burden in making pressure drop calculations.

Fig. 1 enables one to determine quickly whether the flow in a piping system is viscous or turbulent, knowing only the pipe diameter, fluid viscosity and flow rate. Enter the chart at the correct diameter and flow rate. If the point falls above the correct viscosity line, the flow is turbulent, if below, viscous. The chart is based on a Reynolds Number break point from viscous to turbulent of 2,100.

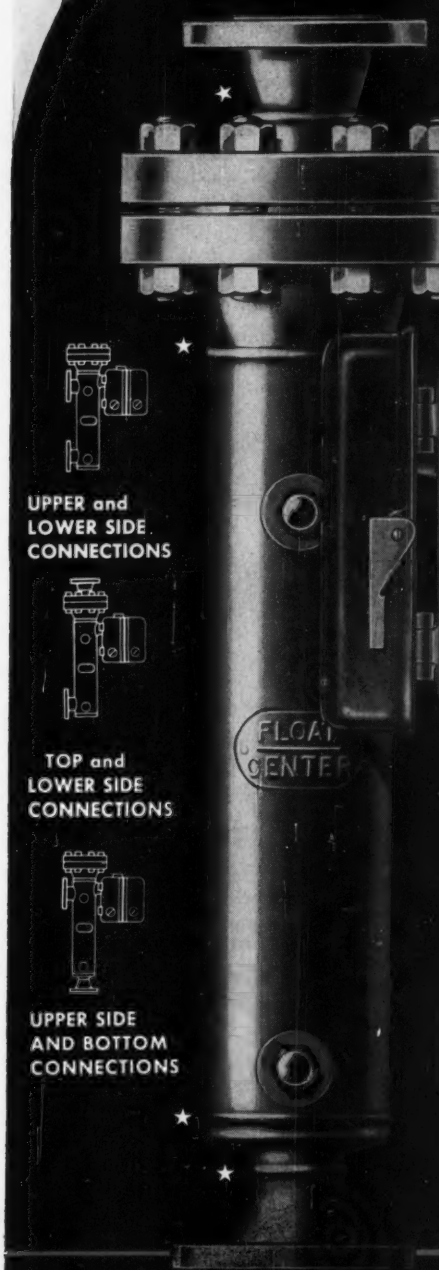
It often occurs in practical piping layouts that the pressure drop through the pipe is negligible compared to that through the pipe fittings. The authors have therefore developed Figs. 2, 3 and 4 to show the pressure loss through screwed, flanged and welded fittings, as a function of flow velocity. In a practical layout the available pressure drop is often set by external factors. By means of this quick check of fittings losses, the designer may find that he must restrict the number of fittings to stay within the available drop.

Fig. 2 can also be used for sudden enlargement and contraction losses. For enlargements if $d_1/d_2 =$

It's Quality Deserves Consideration

FISHER®

LEVEL-TROL®



UPPER and LOWER SIDE CONNECTIONS

TOP and LOWER SIDE CONNECTIONS

UPPER SIDE AND BOTTOM CONNECTIONS



Factory calibrating or zeroing adjustment produces a correct 3 to 15 pound signal output for full float range operation, as particularly required in liquid level indication. Output signal of controller is linear as related to level height change.

Simple level adjustment indicating dial.

Pneumatic proportional band and specific gravity adjustment combined in one member.

Small compact relay unit, minimum working parts.

★ All welds are in accordance with ASME code for unfired pressure vessels.

Universally Accepted for

- LIQUID LEVEL CONTROL
- LIQUID LEVEL INDICATION
- INTER FACE CONTROL

Engineered for peak performance the Fisher Series 2500 Level-Trol is designed to give rugged, trouble-free service. It is high in sensitivity and accuracy . . . it is versatile in handling all kinds of liquids, with minimum service attention.

Fisher Bulletin F-3 gives full details . . . write for your copy today!

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

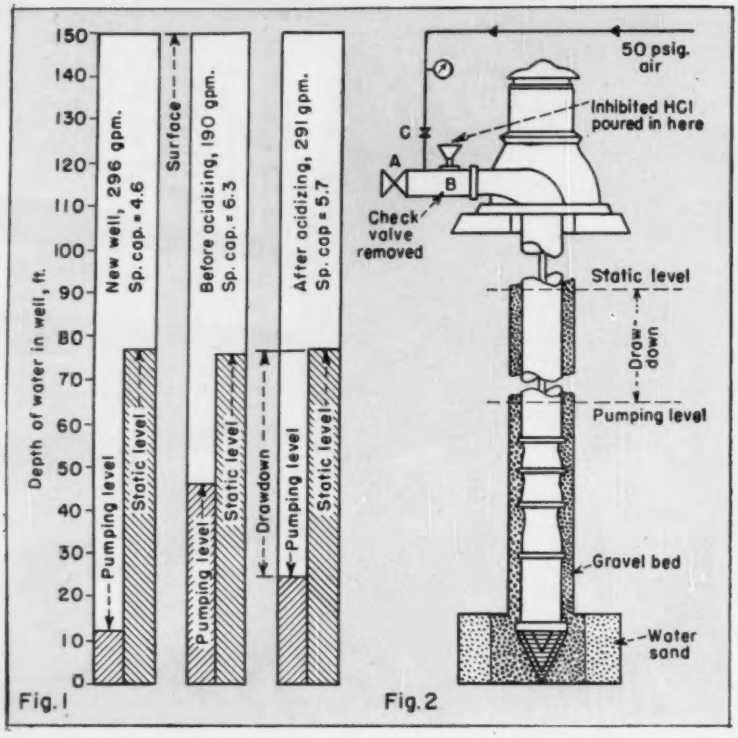
FISHER Since 1880

Comparative Carrying Capacities of Pipes

Pipe I.D., Actual In.....	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
				Viscous Flow				
Relative capacity and length.	0.625	3.2	10	24.5	50.7	160	620	810
				Turbulent Flow				
Relative capacity.....	1.57	4.64	10	18.2	29.5	63.6	115.5	187.8
Relative length.....	0.36	2.5	10	29.1	66.9	27.6	800	1,950

$\frac{1}{4}$, use curve 8; if $\frac{1}{2}$, use curve 10; if $\frac{3}{4}$, use curve (9-10). For contractions if $d_1/d_2 = \frac{1}{4}$, use curve 11; if $\frac{1}{2}$, use curve (11-12); if $\frac{3}{4}$, use curve 12.

The accompanying table, giving relative carrying capacities for various internal diameters of pipe, is helpful in determining the number of pipes of a given size and length that are equivalent in carrying capacity to a single larger pipe. As a corollary, the table also compares the relative lengths of two different diameter pipes having the same pressure drop.



How to Acidize a Water Well

W. F. Knighten, Jr.

Asst. Plant Chemist, Carthage Gasoline Plant, United Gas Pipe Line Co., Carthage, Tex.

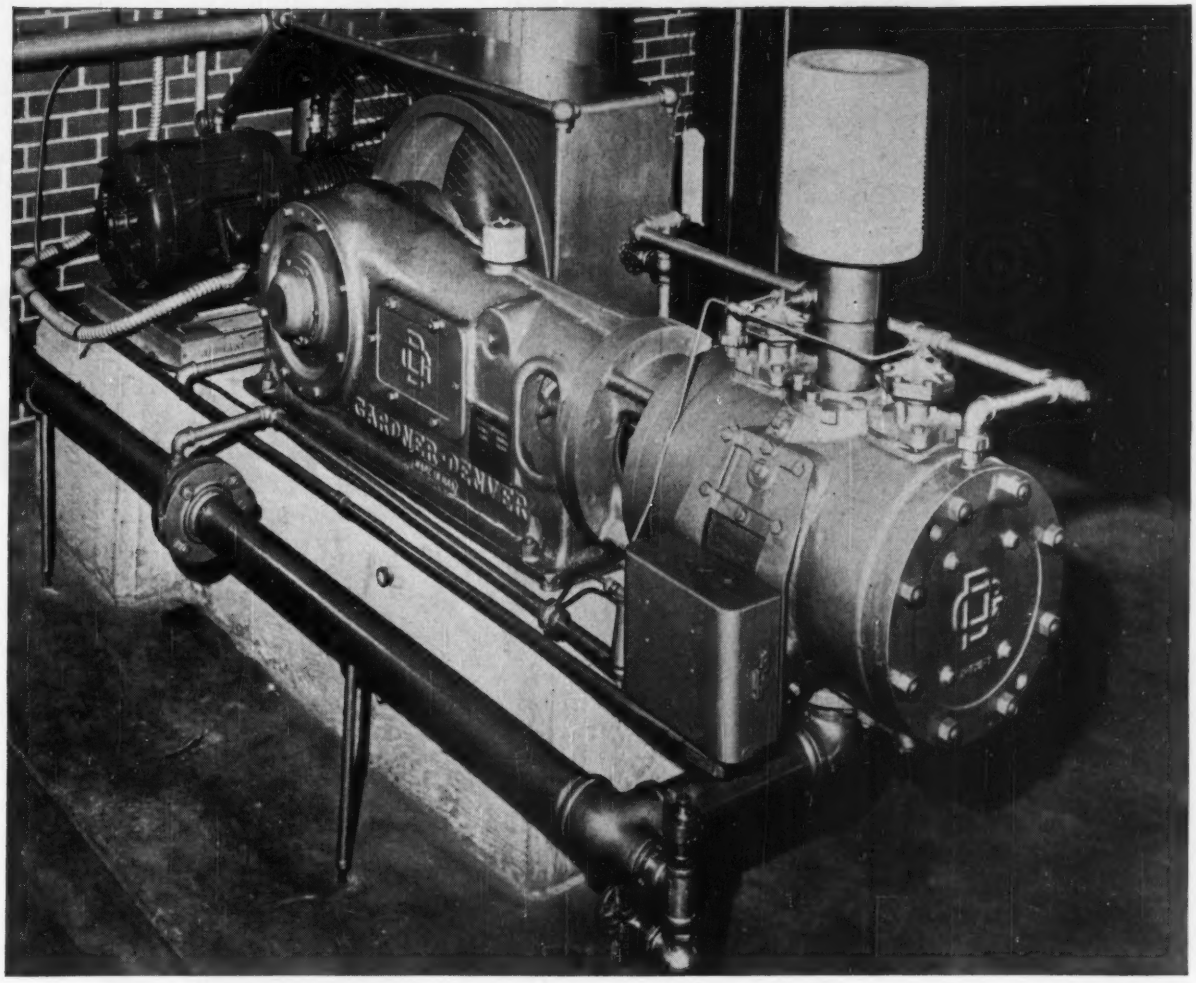
During the course of two years a new 150-ft.-deep water well dropped from 296 gpm. to 190 gpm. open flow. We concluded as the result of tests that the capacity drop was due to the formation of iron scale in the discharge column of the deep-well turbine pump. That being the case, acidizing would probably restore the flow.

Fig. 1 shows a plot of well and water depth. It will be observed that the static water level had dropped only about a foot in the two years but that, whereas the drawdown was 65 ft. originally when pumping at 296 gpm., it was only 30 ft. two years later when pumping at the lowered rate of 190 gpm. In terms of the specific capacity, which is a measure of the productivity of the well expressed as the ratio: Gpm./ft. drawdown, the original specific capacity was 4.6 gpm./ft. However, it had risen to 6.3 gpm./ft. at the later date. This showed that the productivity was still good, but with the lowered drawdown, indicated plugging within the pump bowl, or in the discharge column, or both.

Fig. 2 gives an idea how we carried out the acidizing job. First the discharge valve *A* was closed and the check valve *B* removed. Four carboys of inhibited HCl was poured into this opening and allowed to drain into the discharge column. Then the check valve opening was sealed off and the pump started with the discharge valve closed. This brought the water to the surface level. As soon as the water came to the surface the pump was stopped. This was repeated every 30 min. for 5 hr.

Then valve *C* was opened, allowing air pressure to force the liquid out of the discharge column into the formation and gravel bed. This was repeated at 30-min. intervals for 3 hr. Between blows, valve *A* was opened to the atmosphere to release the air pressure that had built up within the well discharge line.

Finally, the pump was started and the well allowed to discharge to the ditch until the water ran clear and the pH was normal. At this point the well capacity was over 100 gpm. higher than before the acidizing, or 291 gpm., showing the effectiveness of this simple and inexpensive method.



For oil-free air . . . install the GARDNER-DENVER Carbon Piston Compressor

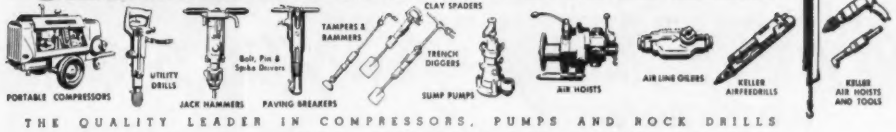
Delivers pure, oil-free air that's safe for foods, beverages, chemicals, textiles, and instrumentation.

Uses no oil in the cylinder — has self-lubricating carbon piston, piston rings, and packing.

Delivers low-cost air that's economical for general plant uses as well as special, oil-free needs.

Write for full specifications — ask for Bulletin CRC-10.

GARDNER-DENVER



GARDNER-DENVER Since 1859

K KELLER TOOLS

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

Retubing? Rely on

keep Heat



First for Lasting Quality—from Mine to Market!

Phelps Dodge COPPER-BASE ALLOY Tubes to

your Exchangers On-Stream!

- ✓ **Complete line of copper-base alloys** including Bi-Metal combinations to meet special corrosive conditions.
- ✓ **Speedy delivery** from strategically-located warehouses.
- ✓ **Careful analysis of your corrosion problems** by experienced engineering staff.
- ✓ **Quality-controlled fabrication** to assure finest tube properties.
- ✓ **Information and sales service** available from nearest Phelps Dodge district office.*

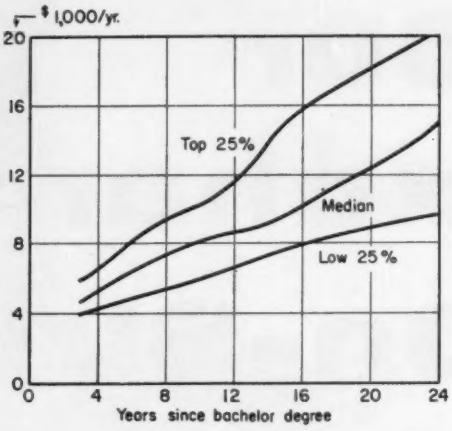
PHELPS DODGE COPPER PRODUCTS CORPORATION
MINE TO MARKET
REG U S PAT OFF

PHELPS DODGE COPPER PRODUCTS CORPORATION

*SALES OFFICES: Atlanta, Birmingham, Ala., Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle Washington, D. C.

Here . . . **Chemical Industry Men Are Paid Like This:**

New York •



How Does Your Current Salary Stack Up?

Here's an exclusive report on the findings of a recent salary survey covering professional men in the chemical industry in and around New York.

How does your present salary stack up against those paid in the New York area? How do today's pay rates compare with those of a few years back?

To provide answers, here are the results of a just completed survey made by the Chemical Industries Association.

CIA, which until a few months ago was known as the Chemical Engineers of Greater New York, questionnaired some 600 professional people in all phases of chemical industry activity located within a 40-mi. radius of New York City.

Bulk in Marketing Jobs

Of over 330 replies, some 140 came from graduates in chemical engineering and about 125 came from chemistry grads. Others held a wide variety of first degrees, and a handful had no degree.

The bulk of the respondents described their work either as administrative or concerned with the many phases of chemical marketing, from market research and advertising to direct sales—although about a quarter of the chemical engineers listed purely engineering jobs, mainly in process development or process engineering.

These proportions correspond roughly to CIA's own membership which now totals about 140.

The curve above charts the salary data returned by all of the survey respondents holding a college degree.

Breakdown of Salary Data

Other curves (next page) break these data down by first degrees. Median salary of those with no degree is $10,000 per year at a median age of 40. Virtually all in this group work in chemical sales and a few fill administrative posts. A third of this group had at least two years of college.

Comparing CIA's curve for those with a bachelor in chemistry with that for chemical engineers brought a surprise. As reported to CIA, salaries for chemistry grads are in close agreement with those of the reporting chemical engineers. Most prior surveys reported higher rates for engineers.

In further breakdowns CIA came up with an explanation for the variance. Over 60% of the chemistry graduates hold additional degrees. With the chemical engineers, on the other hand, only 45% hold added degrees. In addition, over 80% of those with degrees in chemistry fill marketing or administrative posts, less than 10% have the traditionally lower-paying plant or laboratory jobs.

Variables and Effects

Men surveyed who have more than one degree hold a definite (though often slight) salary edge



HNO_3
shipped best in
GATX
solid stainless steel tank cars

Nitric acid must be *pure!* That calls for bulk shipping in solid stainless steel cars. With solid stainless, there's no chance of contaminant pick-up . . . cars last longer, give better service, cost less in the long run.

If you ship liquids in bulk, General American has or can build tank cars to move your product more efficiently. They may be made of steel, aluminum or stainless—lined or unlined—insulated or coil heated. They can be equipped to meet your loading and unloading problems. Of course, each car is backed by General American's 38 major car repair shops and network of district offices for dependable service. Find out how you can benefit from better bulk shipping. Call or write General American today.

typical products successfully shipped in stainless steel cars • *Phthalic Anhydride* • *Ethanolamine* • *Formic Acid* • *85% Phosphoric Acid* • *Chlorosulfonic Acid*

features of GATX stainless steel cars*

*Flued Dome Construction*** • *All-welded tank Jacket and Underframe Insulation and Heating Coils (Available)* • *Stainless Steel Valves and Fittings* • *Safety Dome Platform* • *One-Piece Longitudinal Bottom Plate*

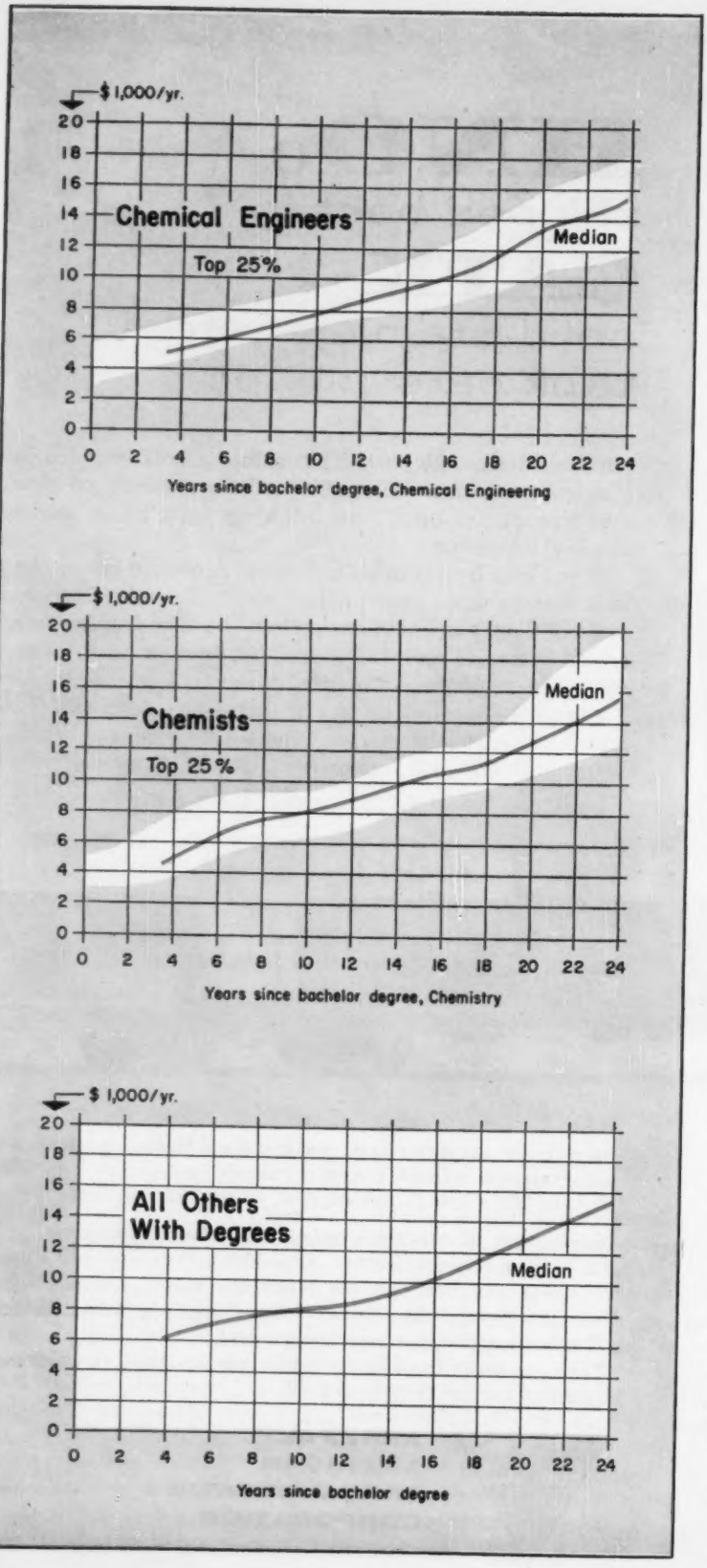
**Standard equipment unless otherwise noted.*

***The one-piece flued dome saddle was designed and pioneered by General American as early as 1938.*

GATX GENERAL AMERICAN TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South La Salle Street • Chicago 90, Illinois



over those without advanced training.

CIA also attempted to determine what effect, if any, time spent in the military has on salary level. The survey shows that of the chemical engineers who graduated since 1935, 57% served in the armed forces. Of those graduating since 1942 about 70% served. For chemists the percentages are almost the same—55% of those graduating since '35 and 73% of those graduating since '42.

Length of time spent in the military varied from a few months to over five years. Average hitch was about two years.

As the graphs (p. 248) show, veterans and nonveterans receive about the same pay for equal experience. Among the ChE's the veterans hold a slight lead but with the chemists the salary curves are virtually the same.

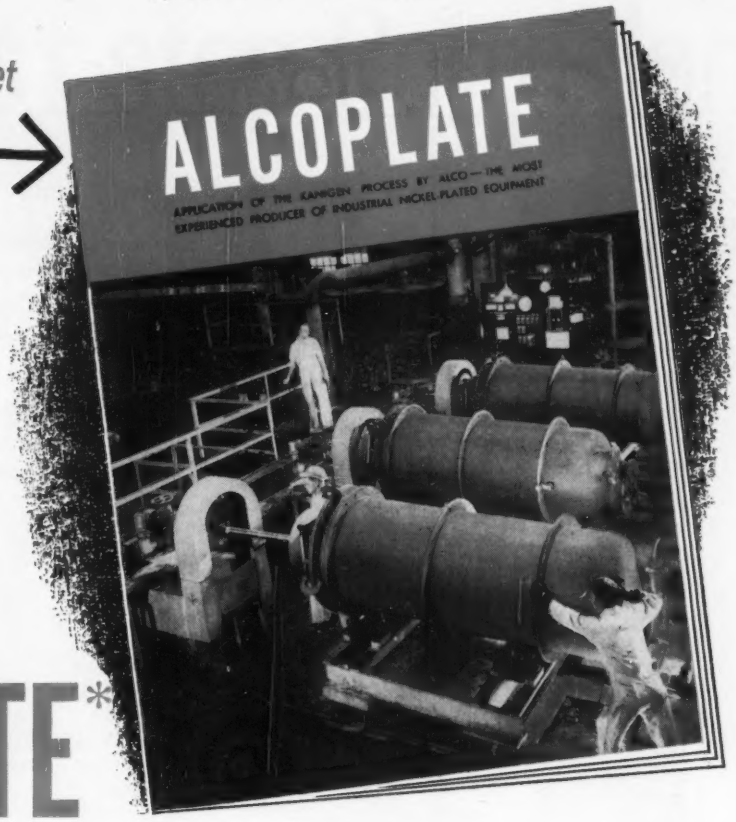
CIA also studied the effect of company size on salaries. This has been treated in previous surveys of the AIChE[1,2] and CIA's findings corroborate the earlier ones. CIA found no significant difference in the median salary of those working for small (less than 1,000 employees), medium (1,000 to 5,000) or large (more than 5,000) companies.

Nearly a fifth of the chemical engineers work for companies in the medium bracket. Their salary medians $8,500 per yr. The rest are about equally split between the larger and smaller firms, and earn median salaries of $8,500 and $9,200 respectively.

Of the chemists, nearly half work for large companies, 40% for the small firms and the rest for medium-size companies. Their median salaries are $10,000, $9,500 and $9,000 respectively. Some 10% of those working for small firms report salaries of over $25,000 per yr. In the main, these are consultants. The same holds true among the chemical engineers who answered the survey questionnaire.

For different types of work, however, CIA found a wide variation in median salaries. Chemical engineers surveyed, for instance, work

Send for this free booklet



ESSENTIAL INFORMATION on the advantages and technical properties of ALCOPLATE *coatings, together with a review of* ALCO*'s experience and facilities in nickel plating, is contained in this recently issued 8-page booklet. For your copy, mail the coupon below.*

ALCOPLATE*

Can be your solution to corrosion or contamination problems

ALCOPLATE is an electroless chemical-plating method that bonds a uniform nickel plate to any base metal—any shape—no matter how complicated it may be. On surfaces impossible to electroplate or clad, coverage is uniform and complete. Plate thickness over all surfaces is within 0.0003 in. of specification on normal assignments. (Plate thickness varies from 0.0027 to 0.0033 on usual 0.003-in. specification.) Corrosion resistance of ALCOPLATE is at least equal to and generally superior to that of pure nickel and other expensive alloys.

Other ALCOPLATE advantages include:

- **Better Composition Than Electroplate —ALCOPLATE** is harder, has almost zero porosity at minimum thickness. In some services where electroplate has failed because of porosity, ALCOPLATE was not affected.
- **Excellent Plate Adhesion—Alcoplated** steel specimens pulled to the yield strength point show no signs of flaking or spalling.
- **High Adhesion Resistance** — Hardness is 48 Rockwell C and can be increased to 66 Rockwell through post-plate heat treatment.

Consult your ALCO Sales and Engineering Representatives at:

ATLANTA, Ga.	NEW YORK, N. Y.
BEAUMONT, Tex.	PITTSBURGH, Pa.
CHICAGO, Ill.	ST. LOUIS, Mo.
CLEVELAND, Ohio	ST. PAUL, Minn.
HOUSTON, Tex.	SAN FRANCISCO, Calif.
KANSAS CITY, Mo.	TULSA, Okla.
LOS ANGELES, Calif.	WASHINGTON, D. C.

*ALCOPLATE—Trade-mark registration applied for. An application of "Kanigen," a mark identifying the chemical deposition of high-nickel, low-phosphorous alloy by General American Transportation Corporation and its licensees and the coating resulting therefrom—on license from the General American Transportation Corporation.

Mail this coupon today!

ALCO

ALCO PRODUCTS, INC.

formerly **AMERICAN LOCOMOTIVE COMPANY**
Schenectady, New York

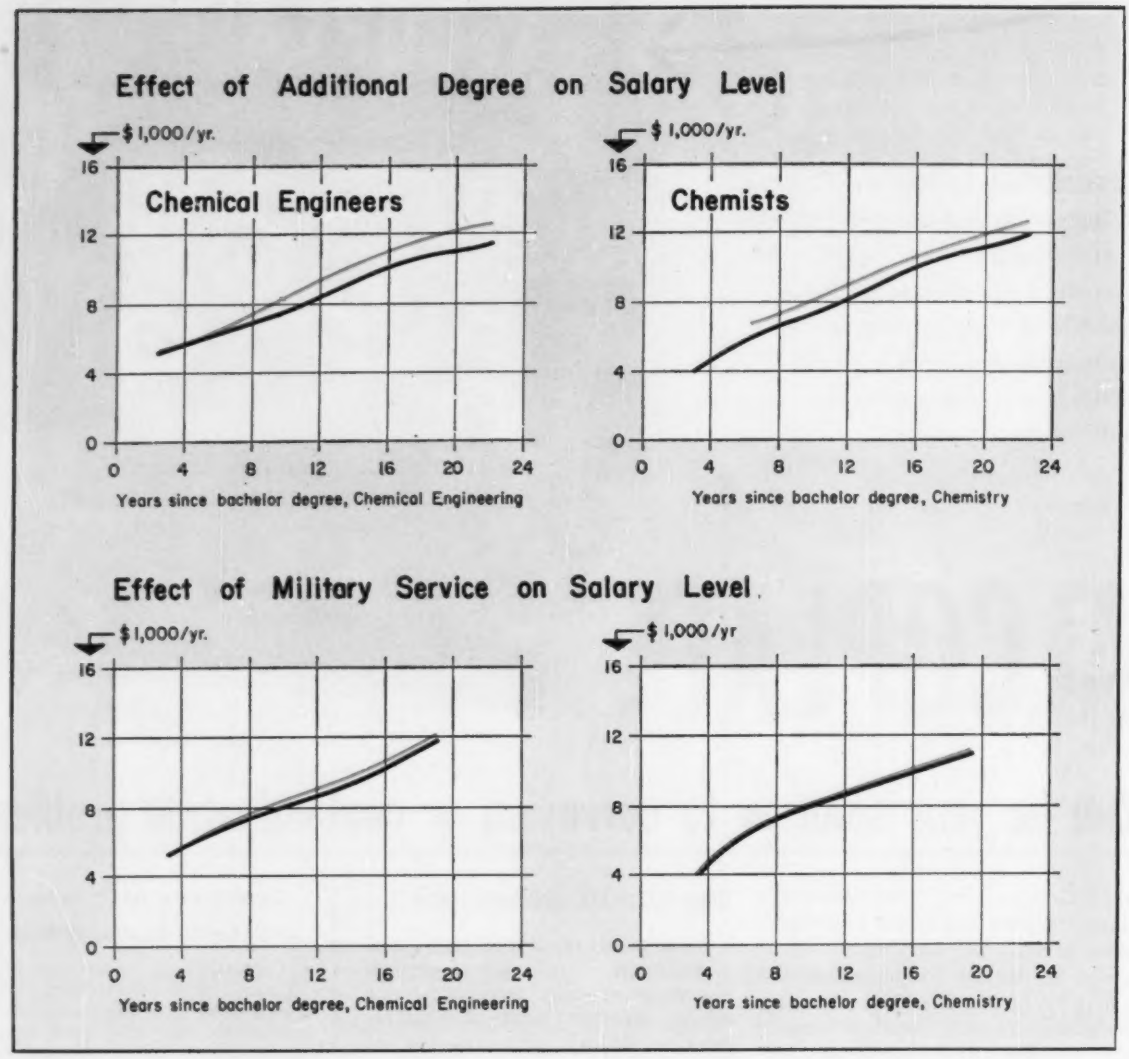
ALCO Products, Inc.
Box No. 1065
Schenectady 5, New York

Please send a free copy of the new ALCOPLATE booklet.

NAME_____ TITLE_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____



principally in three areas; administration (25%), engineering and development (23%) and marketing (40%). Median salaries run $13,000, $8,000 and $8,500 respectively. A handful (6.4%) serve as consultants; their salaries median at $15,000.

Graduates in chemistry included in the survey work in administration (21%) and marketing (64%) in the main. Median salaries for each group are $15,000 and $9,500.

How They Feel About Pay

Reaction of the respondents to the CIA's final question makes one of the most interesting parts of the survey. CIA's query: "In your opinion are you well-paid, poorly-paid or are you satisfied that your pay is just about right for the work you do?" brought 302 answers and was the basis for dozens of comments.

CIA found that of those making less than $7,000 annually, nearly 60% feel they are poorly-paid. None opined that they are well-paid for the work they do. Going up to the $7,001 to $10,000 group cuts the percentage of those who feel poorly-paid to less than 30%, and nearly 10% aver they are well-paid.

Of those making between $10,001 and $20,000, only 10% feel poorly-paid, while 14% feel well-paid. In the over $20,000 per yr. group, none claim they are poorly-paid and almost 40% feel well-paid. In fact, CIA reports that one "over $25,000" respondent, one of several chemical engineers in advertising, declares that he is "overpaid."

From the survey, the lower a man's salary the more likely he is to feel underpaid for the work he does—no matter how much or how little training or experience he has or what sort of work he does.

Possibly the ever-increasing starting salaries paid new men furnish a reason for this unrest. Men in the lowest bracket feel any lack of a real differential between

If you **MUST** stop Corrosion

KEL-F® PLASTIC WILL



KEL-F Plastic Molded and Fabricated Valve Linings, Valve Diaphragms, Gaskets, Ring Seals, Gauge Crystals, KEL-F Dispersion Coated or Laminated Lined Tanks, Vessels, Reactors, Piping and Tubing can protect your plant equipment against chemical corrosion

KEL-F Fluorocarbon Plastic is the best non-permeable, corrosion-proof material available today. It is inert to virtually any type of chemical attack—including mineral acids, oxidizing agents as well as strong caustics. When nothing else will protect equipment, KEL-F Plastic usually will.

HERE ARE SOME OF ITS OUTSTANDING CHARACTERISTICS:

Temperature Tolerance

Exhibits satisfactory properties over a temperature range of approximately 710°F. (—320°F. to 390°F.)

High Compressive Strength

Pressures of 8,000 psi result in only 4% to 5% permanent set. Line seals are retained longer when gaskets and O-ring seals are made of KEL-F Plastics.

Non-Adhesive

KEL-F Plastic is non-wetting even after long periods of immersion. Surface is anti-fouling when in contact with even the most viscous liquids.

KEL-F Plastic is a thermoplastic and easy to fabricate. It is readily molded by extrusion, transfer and injection. Available in sheets, rods, tubing and film, it can be fabricated, heat formed, machined and heat-sealed by a growing list of experienced fabricators.

New! KEL-F Plastic Dispersions

KEL-F Plastic Dispersions have been developed for bake-coating of metallic surfaces that must be corrosion resistant, anti-adhesive and electrically non-conductive. These Dispersions can be applied by spraying, spreading or dipping.

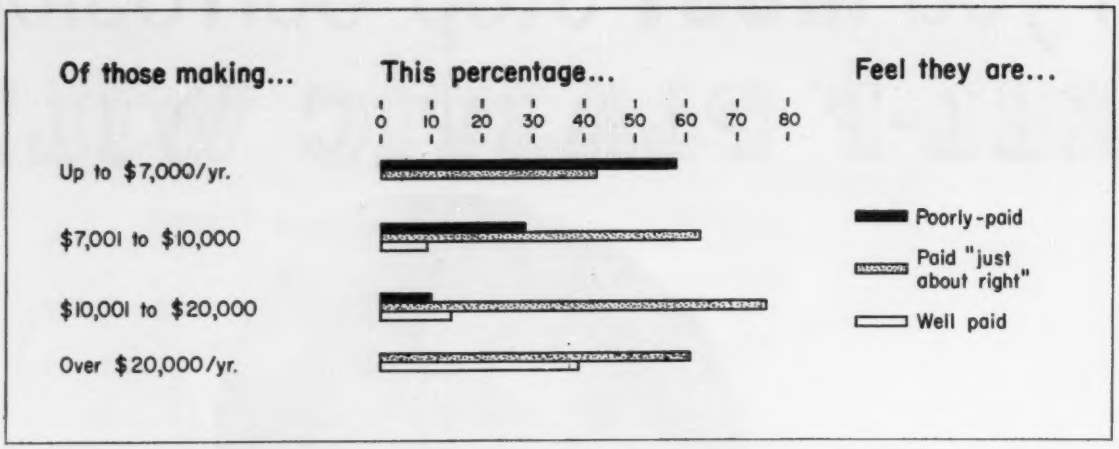
The full story of what KEL-F will do for you is worth having. Write or call for additional information.

THE M. W. KELLOGG COMPANY

Chemical Manufacturing Division,
P. O. Box 469, Jersey City, N. J.

SUBSIDIARY OF PULLMAN INCORPORATED

® Registered trademark of The M. W. Kellogg Company's fluorocarbon polymers.



their salary and the starting rate first—and they are quick to note it.

Almost 5% of those queried, all of whom graduated at least three years ago, now make less than this year's average starting rate for new bachelors, $380 per mo. And about 25% of all replies were from men making less than $7,000. Their experience ranges from 3 to 27 years.

What They Say

Many of CIA's respondents wrote in comments on their job and salary. Here's a sampling:

"I believe professional engineers are, in general, poorly-paid in comparison to unionized labor."

"The responsibilities of this job and the background I have are worth about $1,000 more than present compensation."

"Leaving company for better opportunity."

"The job should be better paid, but the engineering work in our firm is on a pretty elementary level, and I'm about to look for a more demanding (and rewarding) job."

"Poorly paid because of responsibilities involved in position i.e. I am in charge of a fair sized chemical plant."

"The chemical industry seems to have a tradition of steady employment at low pay. In that respect it resembles banking or school teaching."

"Stop encouraging engineers to think they are well paid. They are miserably paid in accord with their usual responsibilities. Start encouraging engineers to be more professional in outlook: by P.E. license; by attitude toward self, work, client (usually employer)."

"Inadequately paid rather than poorly paid."

"Feel am well paid but that pay scale for job should be 50% higher due to responsibility involved."

Not Malcontent Rumblings

About half of those quoted above indicated on the survey questionnaire that their salary is about right for the work they do. So the comments are not bitter rumblings of a small group of malcontents.

In fact, the CIA survey results tally pretty well with a University of Chicago study, as reported in *Business Week* earlier this year.

The Chicago researchers termed the attitude of engineers and scientists in industry "frustrated" and "bitter." And an earlier survey by the National Society of Professional Engineers (Chem Eng., Jan. 1954, p. 234) found that 45% of some 1,400 engineers of all classifications feel underpaid. Others, says NSPE, lament their prospects for advancement, the nature of their work, working conditions, and a lack of recognition of their professional status.

These gripes too are reflected in the CIA survey comments:

"Company does not provide suitable facilities for efficient, satisfying work."

"Believe alleged current shortage of technical manpower is much over-emphasized. Much more efficient use of currently available technical manpower could be made by employing more stenographic and clerical help, and by a clearer definition of technical objectives."

"Not treated with professional dignity."

"Engineering societies can do more by promoting adequate salaries for engineers than by all this huffing and puffing about professional status. The latter is all hogwash promoted by the consulting engineers who dominate the societies."

"We need a union like the AMA."

"I think sometimes we place too much emphasis on salary levels of brother engineers. If we are doing better, we may become smug and complacent, if worse, we may be unsatisfied or unhappy. It's better to measure an engineer's worth by earnings plus many intangibles—satisfaction from pride of accomplishment, teaching, creating and worthwhile contributions to his fellow men. You wouldn't get a nice salary curve—your equation would have too many unknowns—but these unknowns may be most important."

Corroborates Other Surveys

As far as the chemical engineers are concerned, the CIA survey correlates quite well with earlier



Every 10 Seconds

there's a completely new filter face on a

DICALITE FILTERCAKE



For all practical purposes, that means that you have a *continuously fresh* filtering surface—all the time—for consistent clarity and constant flow rate. The mechanism of this is simple. The particles of Dicalite filteraid added to the raw liquor as "body-feed" travel with the liquor into the filter; there they are caught and held by the precoat or filtercake on the filter screens (together with the unwanted solids from the liquor) while the clarified liquor continues through.

This unretouched photograph of a section through an actual Dicalite filtercake shows the even dispersion of unwanted impurities throughout the cake and how easily the clean precoat peels from the screen or cloth. Inset shows surface magnified 75 times.

This continuously fresh filter face means that unwanted solids cannot mass together to blind the screen and halt the filtering action—a point of major importance in the case of slimy, sticky or gelatinous impurities. Instead, they are dispersed, distributed through the filtercake in such scattered fashion that the millions of microscopic channels through the filtercake remain open for maximum throughput combined with exceptionally "sharp" separation of solids.

No matter what your filtration problem, whether it be desired clarity or fast flowrate, it is very probable that it can be answered with one or another of the Dicalite family of filteraids . . . the finest in diatomaceous materials. For complete information, write to

1930 • 1955

25 YEARS

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DIVISION: GREAT LAKES CARBON CORPORATION, 612 S. FLOWER ST., LOS ANGELES 17, CALIFORNIA

AIChE surveys—one a national survey run in 1953, the other covering the New York City-Northern New Jersey area and undertaken in 1952.

CIA's median curve for chemical engineers lies roughly $1,000 per year higher than that obtained in the 1953 study and about $1,500 higher than the 1952 curve—evidence that salaries are climbing all along the line.

Other findings, the effect of advanced degrees, time spent in the military and company size, also bear out the results of the prior studies.

REFERENCES

1. Polack, J. A., Montes, G. E., Smith, L. B., *Chem. Eng. Prog.*, July, 1953, p. 17.
2. Dorsheimer, W. T., Downing, M. L., *Chem. Eng. Prog.*, Aug., 1952, p. 424.

YOUNG PRESIDENTS

. . . *How They Got There*

How do you get to be president of a company grossing at least $1 million a year—before you reach your 39th birthday?

The young Presidents Organization, a group of men who have done just that, recently submitted to a detailed survey of their jobs and their backgrounds.

The survey found that some 53% got to be president by starting their own business, buying control, working their way up or coming from other jobs where they had good records. About 44% took over the reins of a family-owned business, and 3% confess that they married the boss's daughter.

No matter how they reached the top, though, finding enough time to do all that's expected of them is a big problem for nearly all. They report an average work week of about 53 hr. and 14% say they average more than 63 hr. per week.—*Business Week*

PLANT MANAGERS

. . . *Salaries Edge Ahead*

Plant and factory managers and superintendents now earn about $2,000/yr. more, on the average, than their counterparts in the sales field (the regional and district managers). That's what preliminary figures from the American Management Association's fourth annual survey of middle management compensation show.

This is the reverse of what is usually found on the top management level, according to D. H. Rosensteel, director of AMA's executive compensation service. Previous surveys have shown that top sales executive are usually better paid than top manufacturing men.

The 1955 study reports that the average annual compensation of regional and district sales managers is $12,000, compared to $14,000 for plant managers and superintendents. Average age of men in these four posts is 45 yr., and they've averaged four years in their jobs.

This survey, which AMA calls the most comprehensive of its kind, covers the compensation paid to over 3,000 middle management executives in nearly 60 different job functions between the top policy-making level and that of general foreman, in 125 companies.

NEW PLAN

. . . *For Du Pont Men*

Under a recently offered thrift plan Du Pont will add 25¢ to every dollar saved by its employees. The new plan both encourages employees to save and helps them to beome stockholders at no cost to themselves.

As the employees save, via payroll deductions, the company contributes a sum equal to 25% of the amount saved to a trust fund. This money is then used to buy Du Pont common stock for the employee.

It works like this: Every employee with two or more years of service is eligible. When he enrolls under the plan he specifies the amount to be saved per month. The minimum is $12.50 and the maximum he can specify is $37.50. The amount he chooses is deducted each pay period and put into U. S. Savings Bonds, Series E, for him.

Every month the company pays a bank, which acts as trustee, 25% of the employee's deduction. With this money the trustee buys Du Pont stock and holds it in the employee's account. Dividends which accrue will be used to buy more stock. When the employee acquires a full share, it is put in his name and turned over to him, after the required waiting time of two years.

Since Du Pont's purpose is to foster sustained saving, the employee's savings bonds will be held four years. Then they are delivered to him in annual installments.

Stock will also be held for a minimum time from his enrolling in the plan, but delivery time thereafter will vary in accordance with the rate at which the stock builds up in his account.

Since it is a continuing program, once an employee enrolls he may stay in as long as he wishes. If he chooses to drop out, he gets back his money in government bonds and the company's contribution. However, for the latter he must stay in the program for at least one year.

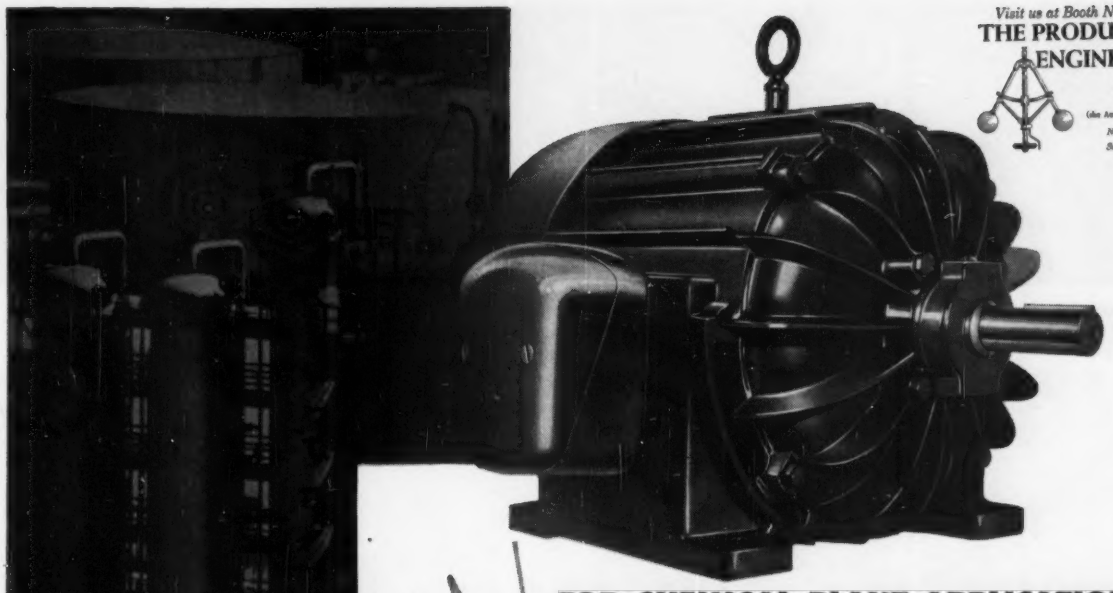
Subject to clearance with several federal agencies, the plan is not expected to get under way until about September 1.

NEXT MONTH:

REGISTRATION

Are you ready for professional licensing? Get a clear picture of the requirements and learn how to tailor your experience to meet them. It's all in August's You & Your Job.

Visit us at Booth No. 429 at the
THE PRODUCTION ENGINEERING SHOW
(the Automation Exposition)
Navy Pier, Chicago
September 6-16, 1955



FOR CHEMICAL PLANT APPLICATIONS

New DIEHL TYPE "DIF"

totally-enclosed, fan-cooled MOTORS

Designed specifically for the Chemical Industry to specifications outlined by chemical plant engineers. Corrosion and moisture resistant features throughout provide long life, minimized maintenance and top efficiency. On dryers, agitators, ball mills, mixers, vibrators, pumps, blowers, compressors and other processing machinery, these rugged motors give uninterrupted dependable performance under the severest operating conditions. For indoor or outdoor service, specify the Type "DIF" Motor for maximum protection.

Here's your assurance of protection against chemical liquids, vapors, gases, fumes, powders and dusts:

- Corrosion and moisture resistant poly-vinyl finish
- Heavy cast-iron totally enclosed construction
- Large cast-iron corrosive resistant terminal box
- Special bronze alloy ventilating fan
- Poly-vinyl insulated stator leads with non-hygroscopic, non-aging, chemical resistant characteristics
- Multiple-insulated stator windings
- Double-protected rotor components
- Oversize pre-lubricated ball bearings

Background photograph courtesy of Standard Oil Co. (N. J.)

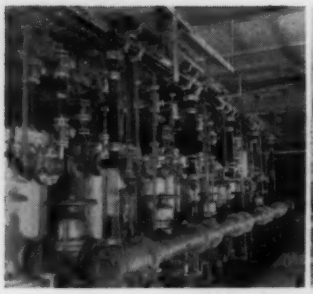
DIEHL MANUFACTURING COMPANY
Electrical Division of THE SINGER MANUFACTURING COMPANY
Finderne Plant, SOMERVILLE, N. J.

Please send me the following bulletins:

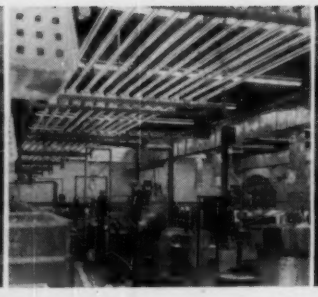
☐ Type "DIF" Chemical Motor Bulletin No. CE-3379
☐ Consolidated Motor Catalog and Price List No. CE-3310

Name_____
Company_____
Street_____
City_____ State_____

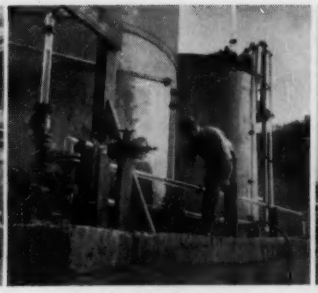
OTHER INTEGRAL AND FRACTIONAL HORSEPOWER MOTORS ARE AVAILABLE IN A WIDE RANGE OF TYPES AND SIZES



Hydrogen Peroxide



Sensitive Dyes



Chlorinated Hydrocarbons



Disposal of Waste Acid Gases

These 12 users needed the **corrosion resistance** of PYREX pipe

Were they worried about breakage?

Probably.

And if you share the same need and have the same doubts, we can imagine your position.

On one hand, you're plagued by the high-cost and headaches of pipeline corrosion — constant replacement, clogged lines, interrupted production.

On the other hand, nagging doubts keep you from making the one decisive test that could, in time, lead to your saving your company untold amounts of money. The test? An actual installation of PYREX brand glass pipe.

You're afraid it will break.

If you've never had any experience with PYREX pipe, that's understandable. Almost every purchaser of this pipe has had to overcome this fear by logically measuring the value of its corrosion resistance against the possibility of breakage.

How these companies found out

It would be safe to say every one of the 12 companies represented in the pictures went through a worry period before approving the first glass pipe installation.

And most of these installations began in the same way:—buyers installed a *test length* of PYREX pipe. Sometimes it was a length of glass between metal lines; sometimes a length where corrosion's effects would be most brutal and breakage most likely.

Experience banishes fear of breakage

Obviously these companies were satisfied with results, else they wouldn't have PYREX pipe in their plants today—miles of it in some cases, and some of it in use for 20 years.

Tests showed them, as a test would show you, that experience with PYREX pipe banishes fear of breakage—that it is safe for you, too, to take advantage of the tremendous corrosion resistance of glass in your processing lines.

Suppose you tried a test—what might you learn . . .

About corrosion?

You'll find that PYREX pipe does a superlative job with such acids as sulphuric, hydrochloric, nitric, acetic; and with such other chemicals as chlorinated hydrocarbons, hydrogen peroxide, bromine, brines, and low-concentration alkaline solutions.

This chart shows you chemical corrosion rates with representative corrosive chemicals.

CHEMICAL CORROSION RATES—Glass No. 7740

Reagent	Temp. F.	Time, Hours	Weight Loss, Mg per Sq Cm	Inches, Thickness Lost per Year
5% NaOH	212	6	1.4	.36
N/50 Na_2CO_3	212	6	.12	.031
5% HCl	212	24	.0045	.0003
3% NH_4OH*	176	100	.33	.0051
85% H_3PO_4	212	24	.009 to 0.19	.0006 to .0010
H_2O	212	6	.0005	.00013 to .00021
		48	.0066	
5% Sea salt	212	24	.03 to .08	.002 to .005
20% Sea salt	104	100	.025	.0004

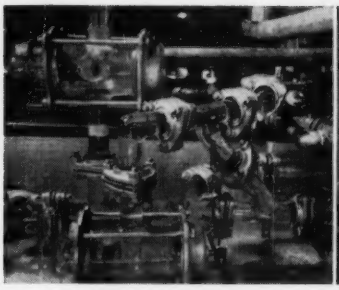
*Maximum corrosion rate for this temperature occurs for concentrations between 0.5 and 3.0%.

About cleaning?

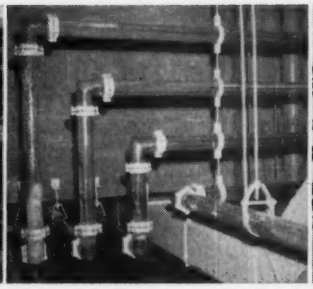
You'll welcome the freedom from slowed-up, sludge-filled lines that PYREX pipe gives you. Hard, smooth glass offers no purchase for costly buildup. And you can clean glass pipe with an acid or detergent agent, live steam or clear water. You *see* when pipes are clean—and when they need cleaning.

About installation?

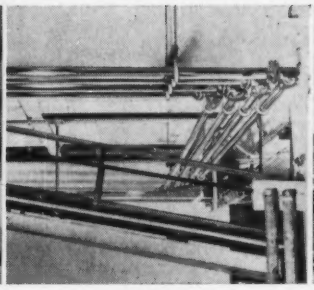
Over 75% of the PYREX pipe now in use has been installed by our customers' own pipe fitters. It's easy to plumb, even with difficult layouts. Hangs easy, too. We have an installation manual to guide your people.



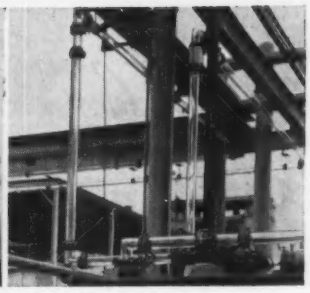
Alkaline Organic Solvents and Muriatic Acid



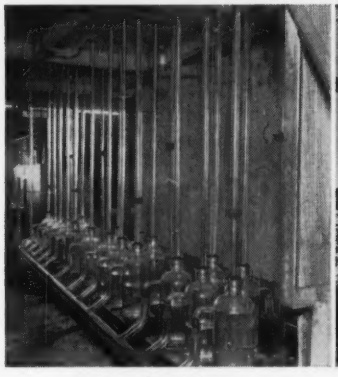
Generating Chlorine Dioxide



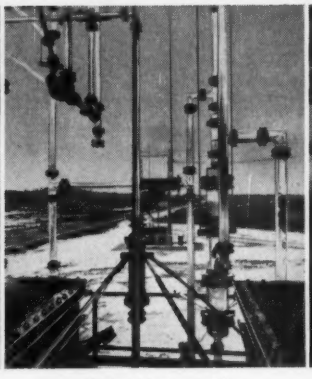
Bottling Plant Lines



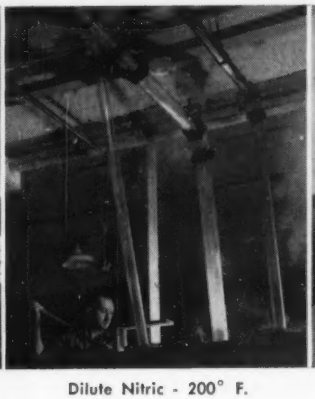
Mono-chloro Benzene



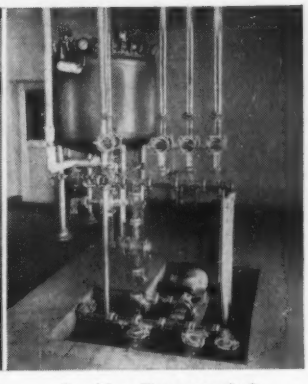
Corrosive Solvents



Hydrochloric Acid



Dilute Nitric - 200° F.



Sensitive Pharmaceuticals

And once PYREX pipe is up, it's up for as long as you need it.

About maintenance?

You'll find maintenance limited to occasional inspection of joints and, once in a while, tightening flange bolts.

About cost?

You'll find the installed cost of PYREX pipe as low as *any* corrosion-resistant material and lower than most. Service life is long. You will probably never need to replace the line you first install. Economy is one of glass pipe's most attractive features.

How YOU can find out more

You can depend on us and upon our distributor in your area (see list) for factual answers to any question you might have about PYREX pipe. Write, wire, or phone us or our nearest distributor or send the coupon below for more detailed information about PYREX brand "Double-Tough" glass pipe.

If you are not now enjoying the trouble-free corrosion-resistance of PYREX *brand glass pipelines because you are worried about breakage, why not talk to some of the people who are using it daily? We'll be glad to furnish the names of companies near you.*

DISTRIBUTOR LIST:

BELMONT, CALIFORNIA
Glass Engineering Laboratories

NEW HAVEN, CONNECTICUT
Macalaster Bicknell Company

ATLANTA 1, GEORGIA
Will Corporation of Ga.

CHICAGO 44, ILLINOIS
Fred S. Hickey, Inc.

NEW ORLEANS, LOUISIANA
W. H. Curtin & Company

CAMBRIDGE 39, MASS.
Macalaster Bicknell Company

ST. LOUIS 4, MISSOURI
Stemmerich Supply Inc.

LODI, NEW JERSEY
Mooney Brothers Corporation

ALBANY 5, NEW YORK
A. J. Eckert Ind. Sales Corp.

ROCHESTER 10, NEW YORK
Will Process Equipment Corp.

PITTSBURGH 19, PA.
Fisher Scientific Company

HATBORO, PA.
Sentinel Glass Company

HOUSTON 7, TEXAS
W. H. Curtin & Company

SEATTLE 4, WASHINGTON
Scientific Supplies

MONTREAL 3, QUEBEC, CAN.
Fisher Scientific Company, Ltd.

TORONTO, ONTARIO, CAN.
Fisher Scientific Company, Ltd.

VANCOUVER, B. C., CAN.
Scientific Supplies

CORNING GLASS WORKS, CORNING, N. Y.

Corning means research in Glass

CORNING GLASS WORKS, 17 Crystal St., Corning, N.Y.

Please send me the bulletins checked below:

- ☐ EA-1: "PYREX Pipe in the Process Industries" (Illustrated case histories)
- ☐ EA-3: "PYREX brand 'Double-Tough' Glass Pipe and Fittings Catalog"
- ☐ PE-3: "Installation Manual for PYREX Pipe"
- ☐ Please have your representative call on me.

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

	CHROMIUM CONTENT* A measure of ability to resist oxidizing corrosives	NICKEL & MOLYBDENUM CONTENT* A measure of ability to resist reducing corrosives	IRON CONTENT*
Type 316 Stainless	17	14	66
20 Alloy	20	31	45
Nionel	21	43	31
Hastelloy C	16	71	6
Chlorimet 3	18	78	3

*Approximate percentages

Versatile New Alloy Available

Ability to resist both severe oxidizing conditions and severe reducing conditions—without excessive cost —is the outstanding feature of Nionel.

A versatile high nickel alloy, which is capable of resisting corrosive attack in a large number of hot acids and mixtures of acids, is announced for the first time by International Nickel Co.'s Bayonne Research Laboratory.

Called Nionel, it has a nickel content of approximately 40%. It also has about 21% chromium, 3% molybdenum, 1.75% copper, 31% iron and small amounts of manganese, silicon and carbon. The relatively high nickel content plus molybdenum and copper make the alloy considerably more resistant to hot sulfuric, sulfurous, and phosphoric acid solutions than any of the common stainless steels. The chromium content is sufficient so that when fortified with nickel, the alloy resists a wide variety of oxidizing chemicals.

Its behavior in specific chemical environments may be summarized:

In sulfuric acid, Nionel shows useful resistance to solutions up to about 70% concentration at 176 F., and 40% concentration at boiling temperatures. It is expected that Nionel will find major applications in the sulfuric acid pickling of iron, steel and copper-base alloys; in petroleum refineries, synthetic detergent plants, rayon manufacture, and ore processing plants, among others.

Nionel is superior to certain alloys presently used to handle hot sulfurous acid and will be used to handle combustion gases and condensates from sulfur-bearing fuels as well as in the pulp and paper industries.

A very useful degree of resistance to hot phosphoric acid solutions has been indicated by Nionel. A principal field in which Nionel shows wide promise is the wet process for producing phosphoric acid from phosphate rock.

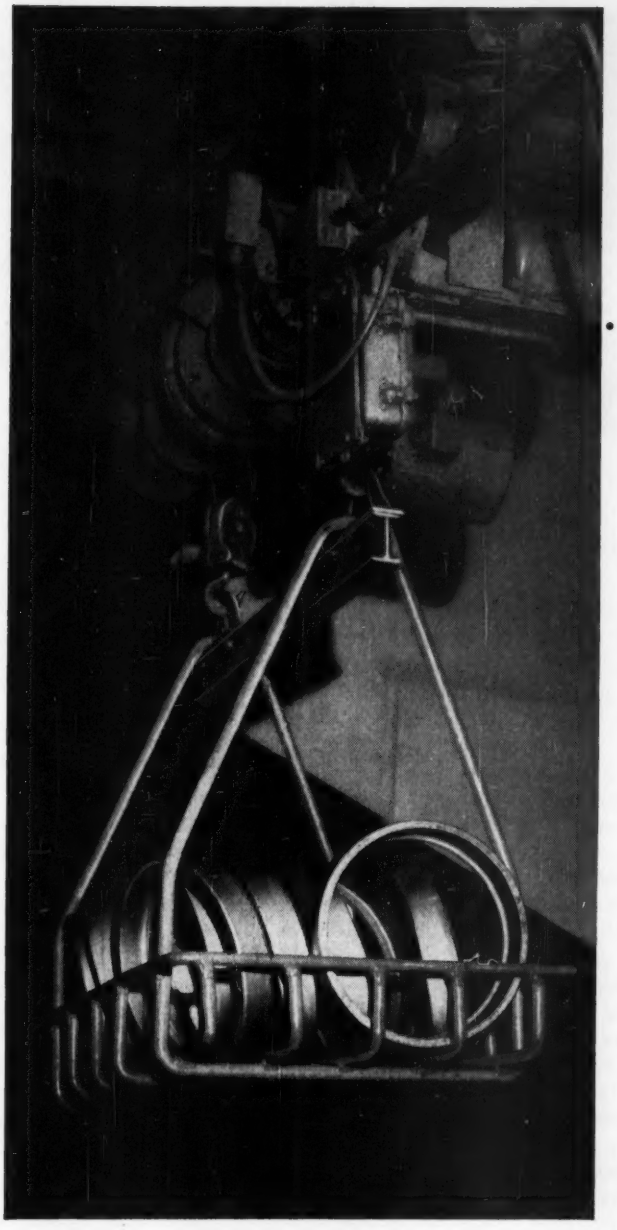
Nionel is resistant to nitric acid solutions of practically all concentrations and temperatures, but will probably find its most useful application in mixtures of nitric with other difficult-to-handle acids. Nionel also shows high resistance to such oxidizing chemicals as nitrates and cupric, ferric and mercuric salts (except chlorides). It is highly resistant to most organic acids and shows superior resistance to boiling concentrated acetic acid, acetic-formic acid mixtures, maleic and phthalic acids and a number of others which are corrosive to ferrous alloys.

Nionel shows good resistance to pitting attack in sea water and also to stress-corrosion cracking in chloride solutions. It therefore should have many applications in tubular heat exchangers which must often resist both corrosive process streams and chloride-containing cooling waters.

Nionel is a tough, strong weldable alloy with mechanical properties on the same order as those of Inconel. It is produced in all standard mill forms including plate, rod, seamless condenser tubing, pipe and extruded tubing.

15 times the life in Acid Mixtures

AND STILL GOING STRONG



PROBLEM:

Baskets for submerging alloy steel forgings in hot pickling acids had to be replaced every month because of severe corrosion. The baskets were continually immersed in either 15 per cent hydrochloric acid, aqua regia, 10 per cent nitric and hydrofluoric acids, or 20 per cent nitric acid. All of these acids were at about 140 deg. F.

REMEDY:

The baskets were made of one-inch round bars of HASTELLOY alloy C.

RESULT:

After 15 months' service, three shifts a day, the baskets made of HASTELLOY alloy C are still good.

HASTELLOY alloy C is the most universally corrosion-resistant alloy available today. It has high-strength and is highly resistant to all of the mineral acids. For a copy of a booklet describing HASTELLOY alloys, get in touch with the nearest Haynes Stellite Company office.

HAYNES TRADE-MARK ALLOYS

HAYNES STELLITE COMPANY

A Division of Union Carbide and Carbon Corporation

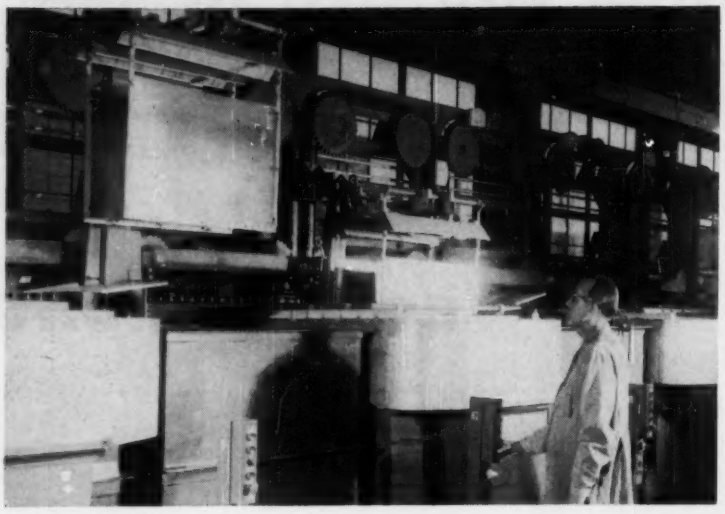
UCC

General Offices and Works, Kokomo, Indiana

Sales Offices

Chicago • Cleveland • Detroit • Houston • Los Angeles • New York • San Francisco • Tulsa

"Haynes" and "Hastelloy" are registered trade-marks of Union Carbide and Carbon Corporation.



For Better Plating . . .

Another new development emanating from Inco's Bayonne Research Laboratory is a new plating laboratory, equipped with the world's only fully automatic pilot plating plant. This pilot plant offers for the first time to industry, on a selective basis, an opportunity to test both new coatings and new processes on a scale as close as possible to an actual industrial plating plant. This is accomplished by means of a fully automatic plating line capable of producing coated metal test panels in large numbers, with an extremely high degree of control to assure uniformity. These panels, together with data obtained in their production, provide the plater with an accurate forecast of the feasibility of a new type coating or plating method.

The automatic equipment has provision for 13 different stages of plating and/or cleaning. The tanks are 400-gal. capacity and include rubber-lined, lead-lined and unlined steel to cover a variety of plating needs. The machine is completely automatic except for loading and unloading and can be used in either single or double line operation handling work up to 3 ft. in cross section. It can be operated entirely from a central panel board where time, current and voltage for each stage of a cycle can be observed and controlled. Power for cleaning and plating operations is supplied by a bank of 6 rectifiers, each rated at 1,000 amp. at 12 volts and 200 amp. at 6 volts. The machine is equipped with a means of fume exhaustion at each station.

An outstanding feature is its great flexibility. Designed for simple handling with a lift truck, the tanks can be quickly moved in any desired sequence. The transferring and conveying mechanism permit work to remain stationary at any given station for as long as desired. Times may vary from as little as 5 sec. to as much as several hours, or even days. Although the machine was designed primarily for automatic operation, it also may be operated manually.

The manual plating line consists of 18 stations and is equipped with rubber- or lead-lined tanks and steel rinse tanks. They range in size from 100 to 300 gal. and can be placed in any sequence desired. The equipment includes pumps and filter presses for continuous filtration of solution, a cathode agitator, a variety of immersion heaters and several heat exchangers. Current is supplied by 7 rectifiers ranging in capacity from 300 amp. at 12 volts to 2,000 amp. at 6 volts. Each station in the manual line is equipped with a means of exhausting toxic or noxious fumes.

In the bench-scale laboratory, solutions are heated with immersion type heaters, sheathed in either Pyrex, quartz or nickel to satisfy a variety of needs. Current is supplied by 12 portable rectifiers connected to an automatic voltage stabilizer. These range in capacity from 25 amp. at 12 volts to 300 amp. at 6 volts. Automatic timers are available for improved accuracy.

Other facilities include a polishing and buffing room, equipment for salt spray testing and a controlled humidity room for storage of metal.

Work of the plating section of the Bayonne Research Laboratory is concerned with the evaluation of new plating processes and coatings, research aimed at new uses for nickel, and research to improve the properties of nickel coatings, with emphasis on enhancing their durability and protective value.

One particularly interesting development, now in progress, is the research being done in cooperation with the container manufacturers and their suppliers of can stock. This involves the extensive investigation of the merits of thin nickel plating for can coatings. Illustrating a typical application for which the automatic plating machine is especially designed, this canning development requires large quantities of uniformly and identically plated steel sheet. By the controlling action of accurate timing devices, it is possible to produce any number of replicate samples or combinations of electrodeposited coatings over a wide range of thicknesses. This feature also makes the machine especially suitable for the production of large quantities of plated corrosion test panels frequently required in cooperative technical society test programs, such as those carried on regularly by the American Society of Testing Materials and the American Electroplaters Society.

Some outstanding developments

"From a corrosion, abrasion and mechanical standpoint,

DURCOPUMPS

are best for the job."

Shown is a part of the Durco equipment in service at Filtrol Corporation's Vernon Chemical Plant. These pumps (and Durco Type K Valves) are handling ammonium aluminum sulfate (alum) slurries and clear liquors with small percentages of sulfuric acid. Temperatures are 150° F. to 220° F.

The Vernon Chemical Plant manufactures high purity alumina and ammonium sulfate.

Filtrol, along with other leading companies throughout the world, uses DURCO chemical service equipment for maximum service life and minimum maintenance when handling severe corrosives.

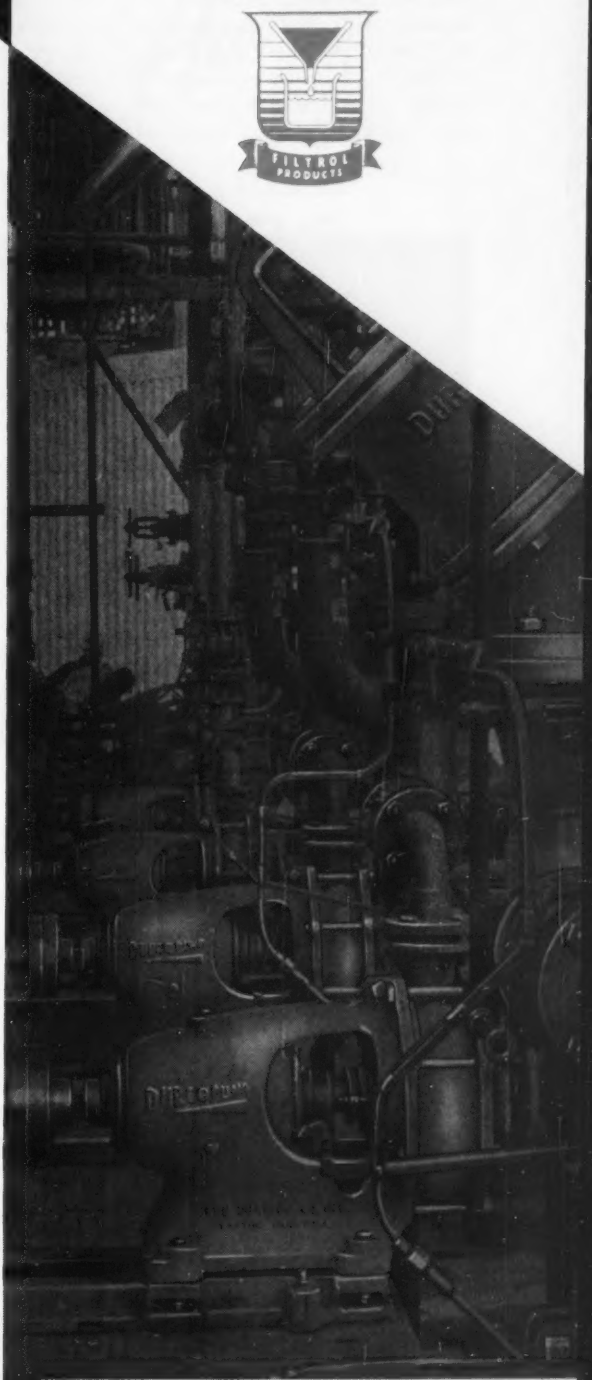
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, Inc.
Dayton, Ohio

BRANCH OFFICES in Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Philadelphia and Pittsburgh.

A **DURCO** installation at
FILTROL Corporation

Vernon Chemical Plant
Vernon, California



Series R Durcopumps are immediately available from stock at Dayton. Write for details.

are: a hard nickel bath widely used for reclaiming worn and mismachined parts; an all-chloride nickel bath for producing medium hard deposits with high conductivity and excellent anode corrosion; methods for making composite metals including nickel-clad ferrous articles; methods for nickel plating with insoluble anodes; fundamental research on the mechanics of the weathering of electrodeposited nickel; and pioneering research in the field of high speed plating in which it was demonstrated that sound nickel coatings can be plated at the rate of approximately 4.0 mils per min.



For Joining Dissimilar Metals

Inco's Bayonne Research Laboratory has also just announced the development of a multi-purpose welding electrode. While all service records and field trials are not as yet complete, it is expected that this electrode will give good, sound welds on better than 90% of dissimilar metal jobs in the average plant. Perfected to the point where it is about to go into production, the new electrode is designed to fill a long existing need for a rod which is capable of making strong, ductile joints between a large number of metals of substantially different compositions.

The area of its greatest usefulness is expected to be in the joining of so-called ferritic materials, like mild steel, to the austenitic or stainless steel compositions. In addition, either group of alloys can be successfully joined to high nickel alloys such as Monel and Inconel.

This development brings to fruition a long standing hypothesis—that high nickel alloy-type compositions are particularly well suited for dissimilar metal welding. To be useful, such an electrode must not only deposit weld metal with adequate strength, ductility and freedom from cracks in spite of dilution by dissimilar combinations, but the electrode must also have a good measure of welder appeal. It must be operable in a vertical position, the slag must be readily removable, and the welds must be free of gas holes. All tests indicate the new electrode will meet these requirements.

Several pilot plant lots have been made and tested in the following dissimilar metal combinations: mild steel to 304 stainless steel, mild steel to 405 stainless, Croloy to 347 stainless, mild steel to 330 stainless, 405 stainless to 316 stainless, mild steel to 316 stainless, mild steel to 310 stainless, 304 stainless to 410 stainless, mild steel to 347 stainless, Croloy to 304 stainless, 405 stainless to 304 stainless, 405 stainless to 310 stainless, 405 stainless to 347 stainless, 405 stainless to 330 stainless, mild steel to Croloy, mild steel to 410 stainless, Hastelloy C to 316 stainless, Monel to 410 stainless, Inconel to 347 stainless, and Inconel to 405 stainless steel.

In all combinations the welds were ductile and crack-free, and the joint strength was sufficient in all cases to force failure in the base metal in tensile tests. In addition, the corrosion properties of the weld deposit, in most cases, were superior to the parent metals involved. It is expected that many other applications will become apparent as field trials are completed.

The new electrode comes in 14-in. lengths in diameters of $\frac{5}{16}$-in., $\frac{3}{32}$-in., and $\frac{1}{8}$-in. There is also a $\frac{3}{32}$-in. diameter with a center grip. The new electrode is an all-position rod operated on direct current, reverse polarity. Recommended amperages are: $\frac{3}{32}$-in. diameter, 40-65 amp., 20-24 volts; $\frac{1}{8}$-in. diameter, 75-100 amp., 23-25 volts; $\frac{5}{32}$-in., diameter, 90-130 amp., 23-25 volts. In general, no preheat, postheat and no peening are necessary.

NEXT MONTH:

PAINTING SPECS AVAILABLE

See next month's Corrosion Forum for the significance to chemical engineers of the painting specifications just published by the Steel Structures Painting Council, Pittsburgh, Pa. These specifications are contained in Volume II of the Steel Structures Painting Manual. They enable maintenance supervisors and design engineers to specify paint in the same easy, precise manner as the steel itself is specified—by reference to a specification number.

---

to

CONTROL CORROSION

where only

MINIMUM SURFACE PREPARATION

is possible

use the

Amercoat 33 over 86 System

There is no substitute for ideal surface preparation. But every maintenance engineer is confronted with corrosion problems in locations where only minimum surface preparation is possible. The Amercoat 33/86 System is amazingly helpful in many of these cases. Here is how it works:

FIRST: apply Amercoat 86 Primer, brushing it well into the surface. This unique primer has a high tolerance for surface contamination and will adhere to many problem surfaces.

- It is both inhibitive and chemically resistant.
- It stifles underfilm corrosion and under-cutting.
- It forms a truly compatible base for vinyl topcoats, eliminating peeling and lamination.

THEN: apply Amercoat 33, the time-tested vinyl coating. Because of its high solids content, you get a thicker, heavier coating—"more mils per gallon". Applied by hot spray* or conventional spray, it takes fewer coats of Amercoat 33 to build the required film thickness.

In addition, you get more economical protection per square foot per year because Amercoat 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions.

**Follow the line of MOST resistance*

**You have the confidence of knowing that more Amercoat 33 has been applied by hot spray than any other vinyl maintenance coating! No need to stock two types of material*

If you have a difficult corrosion problem in your plant, perhaps we can help you. Our fifteen years of specialized experience is at your service. Write for literature and the name of the trained Amercoat representative in your city.

Amercoat® CORPORATION
Dept. AG
4809 Firestone Blvd.,
South Gate, California

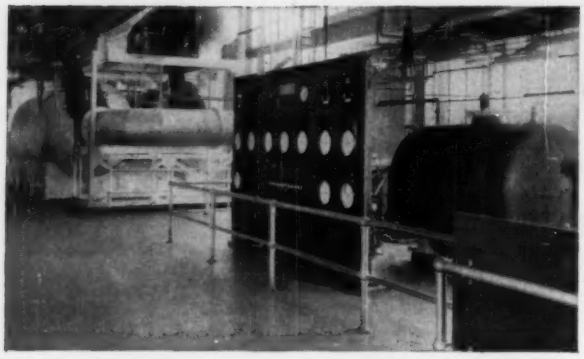
Evanston, Ill. • Kenilworth, N. J. • Jacksonville, Fla. • Houston, Tex.

WHAT'S NEWS AT BRISTOL . . . WHAT'S NEWS AT BRISTOL

Bristol...automation... and you

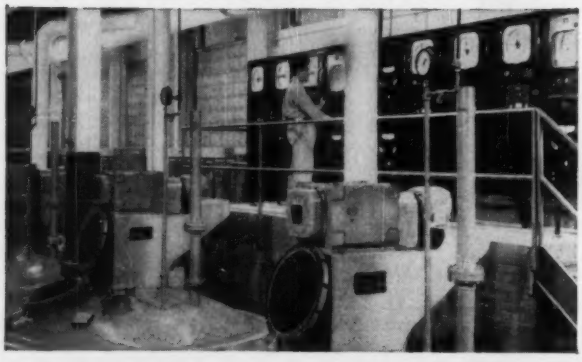
Magic word, automation. Or push-button operation. It's a breath-taking concept, too – plants running practically unattended.

Breath-taking – but not *new*.

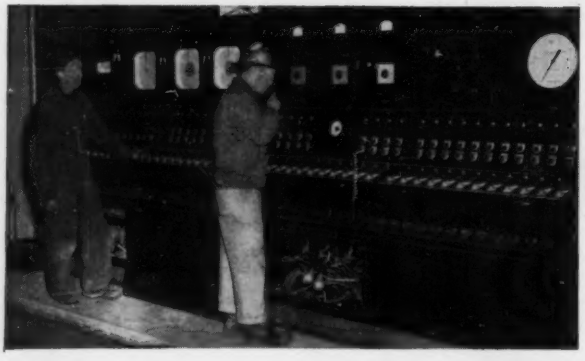


BRISTOL COORDINATED CONTROL SYSTEM automatically controls operation of "Columbia" Activated Carbon Solvent Recovery Plant at the New York Daily News. Similar control systems are used in many other solvent recovery plants designed and supplied by Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation.

BRISTOL'S "MECHANICAL BRAIN" is the leader of the Coordinated Process Control System . . . accurately coordinating all the variables, including mechanical operations, so that each phase of the process takes place in proper sequence.



AUTOMATION is often thought of in terms of plans or even dreams; here at the Buffalo Foam Rubber Products Plant of the Dunlop Tire and Rubber Corporation, it is a reality. This automatic plant, designed and built by Mechanical Handling Systems, Inc., Detroit, uses Bristol Dynamaster® Electronic Instruments and Automatic Controllers as part of a process employing today's most advanced automatic production techniques. The result – greater efficiency and productivity, lower costs, improved product, and stronger competitive position.



THE WORLD'S LARGEST COAL CLEANING PLANT employs automation in lubricating system. The Hanna Coal Co., Adena, Ohio, uses *Bristol Controls and Recorders* in its fully automatic time-controlled centralized system for mass lubrication. This system promotes safety and, above all, insures positive delivery of the right lubricant in the right quantities at the right time to all bearings, regardless of operating conditions.

Twenty-one years ago . . .

'Way back in 1934, The Bristol Company led the way in the field of automation by developing the Bristol Systems of Coordinated Process Control.

These systems automatically controlled and coordinated all of the variables and operations of a process—such as the time of operation of valves, pumps, blowers, dampers, and the control, at a definite value or according to a time program, of variables that affected the uniformity, quality, cost, and yield of a product – such as temperature, pressure, liquid level, flow, pH, humidity, and speed.

RESULTS: They eliminated variations in processing that caused inefficiency – cut down rejections and waste – insured product uniformity – helped cut processing time as much as from 10 days to less than 30 minutes. And these systems quickly paid for themselves.

A REVOLUTIONARY CONCEPT: They brought automatic plant operation to a startling reality and were hailed at the time as a fundamentally new development – which would in time revolutionize manufacturing.

Today, Bristol Coordinated Control Systems are used in the chemical, oil refining, rubber, tobacco, textile, steel, metal working, food, paper, the automotive industries, and many others. They are so completely automatic that it is only necessary to push a button to start up, another to shut down.

The modern solution to processing and manufacturing control problems

Bristol's System of Coordinated Process Control is made possible only by the following unique combination of facilities, which have been developed during 66 years of building and applying thousands of automatic control systems and instruments in practically all industries:

1. The complete line of modern Bristol Automatic, Controlling, Recording, Electronic, and Telemetering Instruments, representing some of the most advanced ideas in instrument engineering.
2. Bristol's Fully-Automatic Time-Cycle Controllers or "Mechanical Brains".
3. Bristol's ability to combine electronics and the mechanical phases of automation.
4. The ability and facilities of Bristol's engineering staff, gained by long experience and Bristol's pioneering work in the field of automation.

Bristol Application Engineering is at your service:

Our application and field engineers are ready to solve control problems involving automation and Coordinated Process Control Systems by working jointly with your research, development, and plant engineers.

Have you an automation problem?

Our application engineers and nation-wide group of field engineers would like an opportunity to work with your technical staff on any problems of automation for which Bristol Controlling and Recording Equipment and Bristol Coordinated Control Systems appear to be the solution. 5.3

BRISTOL PRODUCTS:

Automatic Controlling, Recording, and Telemetering Instruments for:

Pressure, Vacuum, Absolute Pressure, Draft, Differential Pressure, and Barometric Pressure.
Temperature (Thermometers, Potentiometers and Pyrometers).
Flow, Water and Liquid Level, and Specific Gravity.
pH and Conductivity.
Speed of Travel and Rotation.
Humidity.
Voltage, Current, Power, and Load Totalization.
Mechanical Motion, Position and Operations

Including:

Automatic Control Systems
Electronic Potentiometers
Graphic Panel Instruments
Time-Cycle Controllers
Time-Program Controllers
Pneumatic and Electric Controllers
Instrument Panels
Control Valves

Write for our product data sheets. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

BRISTOL

BRISTOL'S

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

 Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.

Unstable Solids Dried Fast

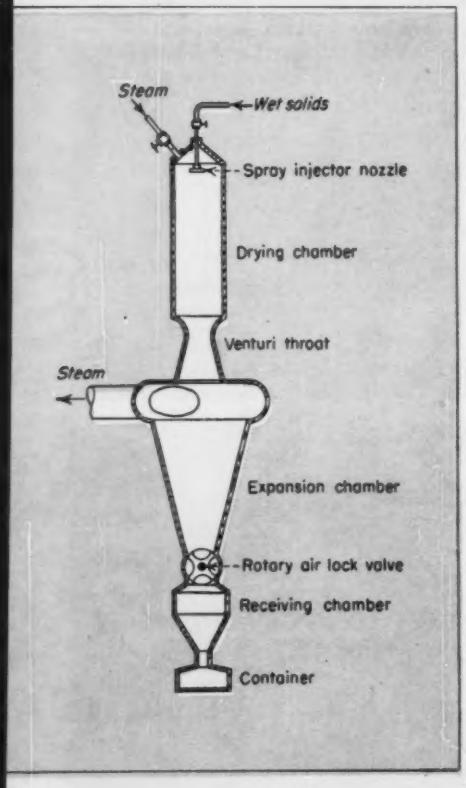
Contact with high-pressure, superheated steam followed by rapid cooling makes possible the dehydration of heat-sensitive compounds.

Dehydrating heat-sensitive solids poses a problem: How can you drive off the water without decomposing the material to be dried?

Research Corp. thinks it has an answer in this novel device which uses high-pressure, superheated steam as a drying medium.

As shown, the apparatus consists of three basic parts—a drying chamber, acceleration throat and expansion chamber.

▶ **Drying Chamber**—Wet, heat-sensitive particles and high-pressure, superheated steam feed into the top of the drying chamber. The high steam temperature causes evaporation at the surface of the particles. But as long as the latter are wet they remain relatively cool. For, the cooling effect of surface evaporation prevents any appreciable temperature rise in the particles.



Contact time between the wet material and steam is controlled so that the particles reach the acceleration throat by the time they're substantially dry.

▶ **Acceleration Throat**—In the throat (a venturi or constricted throat, exhaust-type nozzle) the particles are accelerated to a very high velocity, then ejected—along with the steam—into an expansion chamber. The pressure in this chamber is lower than that in the drying zone.

High particle velocity and rapid expansion tend to:

- Minimize overheating of dry particles (surface cooling by evaporation no longer occurs).
- Promote further evaporation —and cooling—of partially dry particles.
- Make possible the centrifugal separation of steam from dry solids (due to the high kinetic energy imparted to the particles).

▶ **Centrifugal Separation**—The separation of steam and particles is carried out in the expansion chamber (equipped with a centrifugal separator). Steam exits from the top of the chamber. Dry particles discharge—through a rotary air lock valve at the bottom—into a receiving chamber and container.

The apparatus can also be used to dehydrate oxidation-sensitive solids.—**U. S. 2,702,949 by Frank A. Parker, Jr., to Research Corp.**

Pigment-Whitener Made in Electric Furnace

A small, compact, relatively cheap electric furnace—using ordinary graphite electrodes—is featured in a new process for the manufacture of ultramarine, a blue pigment and whitening agent.

▶ **Slow Warm-up**—The furnace is charged with briquets of ultramarine containing china clay, diatomite, soda ash, sulfur and some rosin.

After charging, the current is turned on and the electrodes are slowly heated—at the rate of 50-100 C. per hr.—to about 775 C. This temperature is maintained until that portion of the charge which is farthest from the electrodes reaches a temperature of 700-750 C. During the heating period, gases and sulfur vapor escape from the charge and are sent to a sulfur recovery unit.

▶ **Typical Example**—In a furnace accommodating an 18,000-lb. charge, it takes eight hours to heat the electrodes (spaced no more than 6 in. apart) to maximum temperature. This temperature is maintained for another two hours to complete primary ultramarine formation.

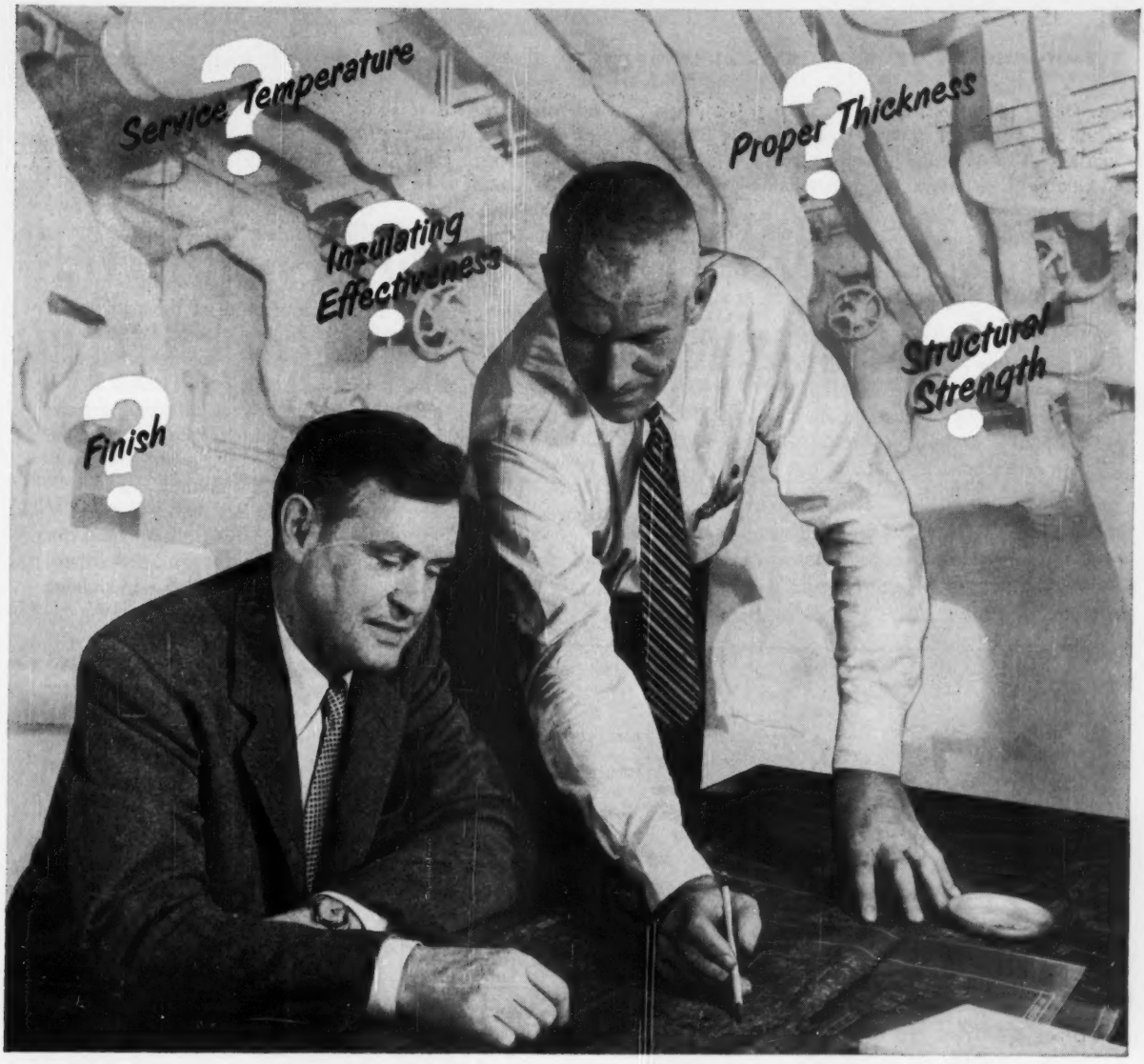
Then the charge is cooled by circulating hot nitrogen—from a gas-fired heater—through it. The flow of nitrogen is such that the charge is cooled to 250-350 C. in about four hours.

▶ **Oxidation**—At the end of this time, SO_2 is added to the circulating gas. And the resulting mixture —10% SO_2, 90% N_2—is used to oxidize the charge.

Since the oxidation is exothermic, the charge heats up to about 350-400 C. The temperature is controlled by the rate at which SO_2 is fed into the circulating gas stream.

When oxidation is complete (at the end of five hours), product is cooled—by steam—to 100-150 C. This takes about three hours.

An additional two hours are then required to empty and re-



Old hands at solving new insulation problems

Your **J-M Insulation Contractor** knows the answers that give you a better, more economical job

To be sure of getting the most efficient insulation for your plant or equipment, see the man with the world's most complete engineering and application service. He's your J-M Insulation Contractor who brings to every job the accumulation of Johns-Manville's 95 years' experience in the thermal insulation field.

J-M Insulation Engineers work hand in hand with J-M Insulation Contractors. Together they have achieved outstanding results with some of the most intricate insulation problems . . . of every type and size—in every industry.

J-M Insulation Contractors provide a complete selection of Johns-Manville quality materials. They will choose from their own stocks the best insulation for your conditions within the broad temperature range extending from minus 400F to plus 3000F.

Skilled application is a major contribution your J-M Insulation Contractor brings to every insulation job. His skilled mechanics have mastered the latest application techniques that assure you top-quality installation . . . give maximum operating economy and lower maintenance costs.

For undivided responsibility on all your insulation requirements, call your J-M Insulation Contractor. Write for the name of the one nearest you. Address Johns-Manville, Box 60, New York 16, New York. In Canada, Port Credit, Ontario.

JM PRODUCTS

Johns-Manville *first-in* **INSULATION**

MATERIALS · ENGINEERING · APPLICATION

charge the furnace, giving an overall cycle of about a day.–**U. S. 2,700,618 by William J. Kruppa and George J. Marlowe to American Cyanamid Co.**

Difficult Separation Made Easy

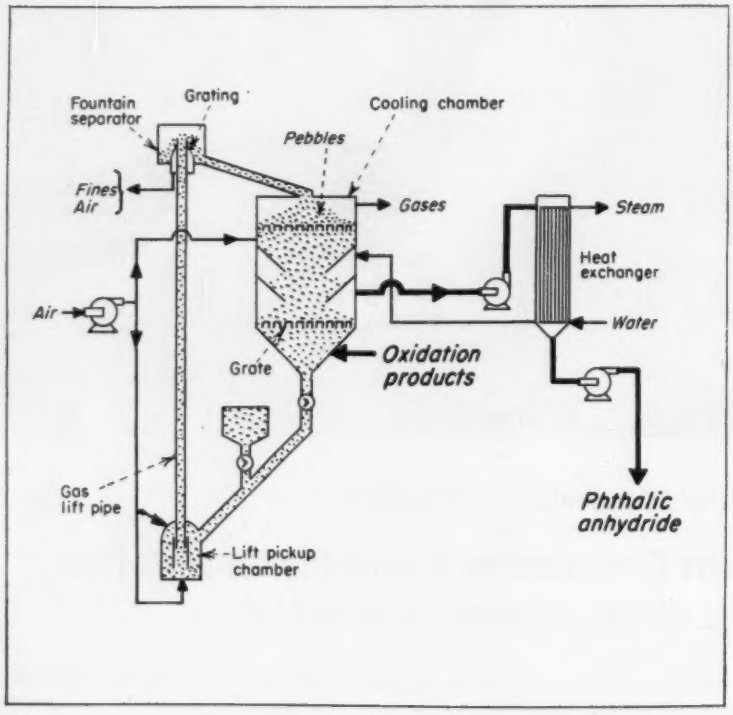
Separating dicyclopentadiene from other benzene foreruns is usually difficult because the dicyclo compound decomposes readily–at high temperatures–into the monomer. And, in turn, evolution of the monomer interferes with the fractionation of the other distillates.

But here's a novel process which obviates these difficulties.

▶**Conversion and Evaporation**–In the new method, alkali-washed benzene foreruns are heated (at 100 C., under pressure) for several hours to convert the monomer to the dicyclo compound.

When conversion is complete, carbon disulfide, benzene and low-boiling unsaturates are vaporized–at 0-25 C.–by an inert carrier gas. Dicyclopentadiene is left as residue.

Vapors are recovered in absorption towers.–**U. S. 2,700,643 by Martin R. Kroger.**



Now, a Pebble Cooler

Moving pebble bed is used to separate phthalic anhydride from other vapor phase oxidation products.

Here's a new technique for separating phthalic anhydride (liquid) from the reaction products of vapor phase oxidation of hydrocarbons. It hinges on the countercurrent contacting of gaseous oxidation products with a moving bed of cool gravel pebbles.

This is how it works: Oxidation products feed into the bottom of a cooling chamber. Air-cooled pebbles enter at the top and move down through the rising gases.

▶**No Escape**–Anhydride vapors can't escape from the top of the cooler becaue they sublime—to a solid—as the gases are cooled. Nor can vapors escape from the bottom. The temperature of the pebbles at the bottom of the cooler is above the anhydride's boiling point, preventing vapors from exiting.

As the process proceeds, a temperature "pinch zone" forms—in the middle of the pebble mass—in which liquid anhydride appears.

▶**Anhydride Recovered**–Part of the rising gases are withdrawn from the cooler at a point where the temperature is 300-350 F.–and above the anhydride's dewpoint in the enriched reaction mixture.

These gases are then pumped into a tubular heat exchanger. Here they are cooled (by water circulating through the exchanger tubes) to a temperature below the anhydride's dewpoint, but above its melting point.

Liquid anhydride, accumulating at the bottom of the exchanger, is withdrawn and either stored or pumped to a purifying unit. Uncondensed gases are returned to the "pinch zone" in the cooler.

Several detailed examples of the process–in operation–are cited in the patent. The inventor also claims that the new technique can be applied to the separation of (1) organic anhydrides other than phthalic and (2) sublimable compounds–provided that these are present in small amounts and have a substantially higher condensation temperature than the rest of the charge gas.–**U. S. 2,702,091 by Calvin S. Smith to California Research Corp.**

Molecular Distillation: Batch or Continuous

Rotating plates highlight a novel device for the molecular fractionation of liquids.

The plates are dipped into hot, distillable liquid. As they rotate they carry part of the liquid up

The highest product yield can best be produced by continuous analytical *control* of the *composition* of a process stream rather than by the secondary control of a stream's environment. Here's how some companies will...

CONTROL PROCESSES CONTINUALLY WITH THE INFRARED ANALYZER

Examine a typical modern chemical plant closely. You will be impressed by how little manpower operates it. The reason lies in the control room. Long rows of recorders and meters and, in some cases, schematic flow diagrams of the entire process nearly fill the room. The bulk of these instruments are controllers: they control the flow of materials; they maintain temperatures and pressures. They provide exactly the right "environment" inside the process streams that experience has shown results in the highest product yield.

The plant is *almost* automatic—"almost," because the Control Laboratory is still a vital link in the system without which the plant would be forced to shut down. Every few minutes samples come into the lab for analysis—from raw materials lines, from intermediate process points and, most important, finished product. Sample analysis indicates just how efficiently the plant is operating and whether or not the finished product meets specifications. An adverse report means controls must be adjusted until the analysis shows "normal" again.

But negative reports can come out of the laboratory even when every control instrument reads perfectly normal. Why? Because these instruments control "environmental variables" (e.g., temperature, pressure, flow rate, etc.). They control stream composition—which is of prime importance—only indirectly. They provide that combination of temperature, pressure and rate of flow which has been established as the best for a particular process. The instruments have no way of knowing when the composition of the feedstock changes, when a catalyst loses its efficiency, or when deposits in a heat exchanger begin to affect its operation.

During the time lag between drawing a sample and receiving a laboratory report, thousands of barrels of product can pass through the stream. When something goes wrong, this "analytical lag" is very costly.

Within the last few years instruments capable of eliminating this analytical lag by providing continuous analytical information in the control room have become commercially available. Perhaps the most promising of these is the infrared analyzer. These instruments, which move the laboratory to the process line, are now in operation on many kinds of chemical processes. *In one ethylene plant, for example, infrared analyzers paid for themselves in about four months.*

These analyzers then help close the gap—but we still do not have a completely automatic plant. Human operators are still required to translate the instrument readings into process variable settings. When more is known about the dynamics of a chemical process, then analytical instruments can be connected directly to the environmental controllers. We have the instruments—but not the chemical knowledge.

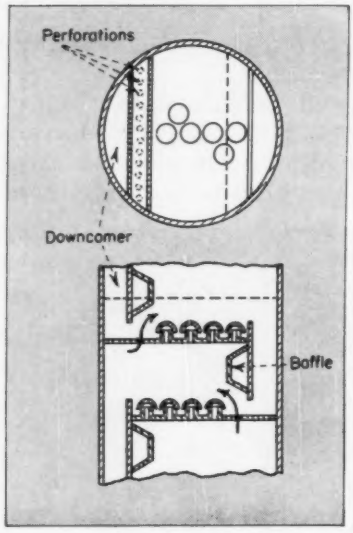


Digest of an article by Paul A. Wilks, Jr., The Perkin-Elmer Corporation, appearing in the March 1955 issue of *Automatic Control*.

THE PERKIN-ELMER CORPORATION, NORWALK, CONN.
First in Analytical Control

alongside condensers which are close (and parallel) to the plates. Some of this liquid distills, is caught in the condensers and collected. The rest (undistillable material) is returned to the still pot. And the process is repeated.

The apparatus can be used for either batch or continuous fractionation.—**U. S. 2,703,310 by Gustave Kretchmar to Givaudan Corp.**



Modified Tower Design Stems Tray Flooding

In an improved bubble-cap tower design, Standard Oil Development Co. provides vapor jets near the downcomers. The object: to minimize the tendency toward tray flooding and consequent excessive entrainment from one tray to another.

▶**Lower Liquid Level**—The vapor streams do a two-fold job. They (1) provide energy to drive the liquid across the tray and (2) produce an aspirating effect. Both these factors cause a decrease in downcomer liquid level. And this, in turn, is said to minimize tray flooding and permit operation of a given tower at somewhat higher throughputs.

About 5-25% of the total vapor flow is allowed to pass through perforations near each downcomer. These perforations, however, must be offset from the downcomer to prevent appreciable vapor flow up into it.

Baffles offset the increased entrainment resulting from the jet operation.—**U. S. 2,702,696 by George F. Pappas, Hollister B. Sykes and Edwin C. Holmer to Standard Oil Development Co.**

Plate-to-Plate Entrainment Measured by New Device

While we're still on the subject of bubble-cap towers, let's take a look at another Standard Oil innovation. This one, a device that measures the entrainment on a tower plate.

▶**Sample Riser**—First, a sample riser is substituted for one of the usual risers. The vapor line from this riser leads—tangentially—into a vapor-liquid separator equipped with an annular tube. Liquid is withdrawn from the bottom of the separator; vapor, from the top. And each stream is measured separately.

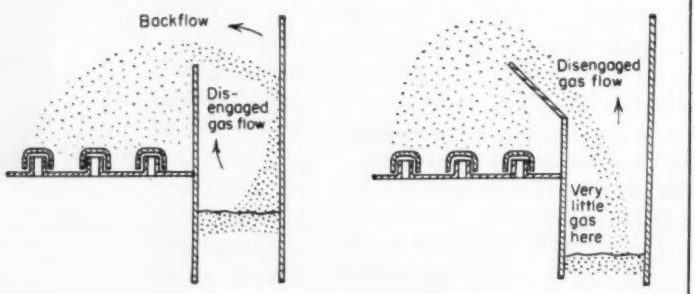
▶**Separator**—The entrainment separator is placed inside the tower so that the temperature throughout the sampling system is the same. Under these conditions, partial flashing of entrained liquid and/or condensation of vapor are avoided.

The rate of vapor withdrawal is controlled so that the dry vapor velocity through the sample riser equals the dry vapor velocity through the bubble-cap risers.—**U. S. 2,703,015 by Hollister B. Sykes to Standard Oil Development Co.**

How To Order Patents

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents per patent.

Conventional weir **New weir**



Bend in Weir Reduces Gas Pocket

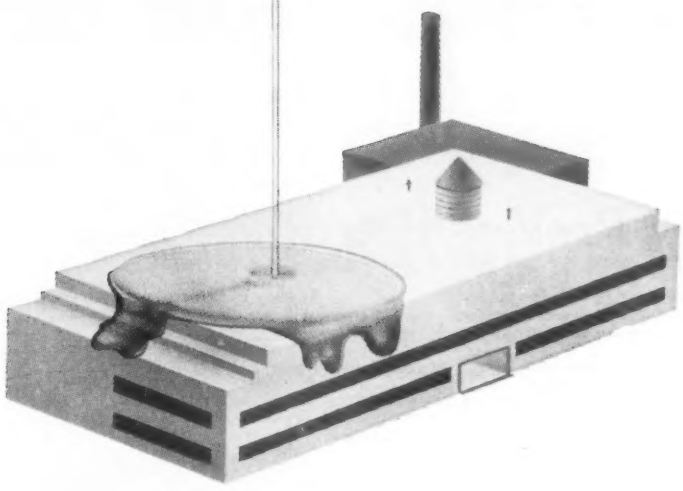
The above sketch shows two sections of a bubble-cap tower used in contacting fluidized solids with vapors. The one on the left is conventional—with a straight, vertical weir. The one on the right has a new Standard Oil Development Co. modification—a bend in the weir.

Claims for the improved design—over the conventional—are: (1) better over-all operation, (2) less trapped gas in the downcomer, thus minimizing backflow and turbulence, (3) increased solids density in the downcomer, eliminating the need for wide plate spacing.—U. S. 2,702,742 by George O. Hillard, Jr. to Standard Oil Development Co.



If you use water in your process...

USE EMULSIFIABLE A-C* Polyethylene



for the first time . . .
a polyethylene that is emulsifiable in water!

If water is your processing medium . . . if you use water in any stage of your operations . . . you should try emulsifiable A-C POLYETHYLENE.

With low-molecular-weight A-C POLYETHYLENE, you can prepare fine particle size, stable, clear emulsions which may be applied with any equipment now employing water systems.

Emulsifiable A-C POLYETHYLENE is now available in quantity for commercial trials. If you will write us on your business letterhead indicating your intended use, we will send you literature or such information as you may require.

SEMET-SOLVAY PETROCHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street, New York 6, N. Y.
New York • Cleveland • Chicago

Allied Chemical

*Trade Mark

Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No.
Chemical reaction	Apparatus for controlling synthesis reactions	Phillips Petroleum Co.	2,702,238
	Tower reactor	Celanese Corp. of America	2,702,741
	Device for conducting heterogeneous chemical reactions	Sec. of the Interior	2,703,275
Extraction	Liquid-liquid contactor	Phillips Petroleum Co.	2,702,236
	Solvent extractor	Vulcan Copper & Supply Co.	2,703,274
Extrusion and molding	Extrusion of thermoplastic materials	Union Carbide & Carbon Corp.	2,702,408
	Extruding plastic cpds.	Western Electric Co., Inc.	2,702,410
Evaporation	Concentrating charrable heat-sensitive liquids	Swift & Co.	2,702,594
Filtration	Filter press plate	British Filters Ltd.	2,702,126
	Disk-type filter	Werner Kunstorff	2,703,177
Fluid and particle flow	Multiple lift for elevating granular solids	Houdry Process Corp.	2,702,207
	Gas lift disengager	Sun Oil Co.	2,702,208
Gas absorption	Gas washer	S. P. Kinney Engineers, Inc.	2,702,699
Heat transfer	Table feeder for pebble heater apparatus	Phillips Petroleum Co.	2,702,133
	Thermostatic control for vaporizers	Edward J. Pagendarm	2,702,989
	Indirect fluid heater	Petro-Chem Process Co., Inc.	2,703,072
	Heat transfer apparatus for granular material	Holly Sugar Corp.	2,703,225
	Wall construction for fluid heat exchange installation	Babcock & Wilcox Corp.	2,703,559
	Heat interchanger for use in solvent recovery	Modine Mfg. Co.	2,703,700
	Heat exchanger with short strip fins	Modine Mfg. Co.	2,703,701
Instrumentation and control	Rotational viscometer	Socony Vacuum Oil Co., Inc.	2,703,006
Mixing	Screw mixer and blender for viscous materials	E. I. du Pont de Nemours & Co.	2,702,184
	Hermetically sealed fluid agitator	Parke, Davis & Co.	2,702,693
	Foamless stirring and homogenizing apparatus	Fondazione Emanuele Paterno	2,703,304
Screening	Vibrating trommel screen	Leon M. Dekanski	2,702,633
	Cartridge-type mechanism for vibrating screens	Allis-Chalmers Mfg. Co.	2,702,634
Solid-gas separation	Pipe rapper transmission system for an electrical precipitator	Research Corp.	2,702,090
	Air-cleaning device	Thomas W. Carraway	2,702,695
	Separation of finely divided solids from gases	Carl Glinka	2,703,151
Solid-liquid separation	Solids discharge mechanism for centrifuges	Sharples Corp.	2,703,676
Solid-solid separation	Classification of particles	Sharples Corp.	2,702,630 & 2,702,632

. . . And New Process Patents

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No.
Detergents	Sulfonate detergent production—treating alkyl aromatic hydrocarbons with a hypochlorous acid	Universal Oil Products Co.	2,703,330
	Preparing sulfonated alkyl aryl detergent slurries	Purex Corp. Ltd.	2,703,788
Fats and oils	Refining fats and oils	De Laval Separator Co.	2,702,813
Gases	Hydrogen fluoride production	Pennsylvania Salt Mfg. Co.	2,702,233
Inorganic chemicals	Froth flotation separates KCl from sylvinite ore	Mines Domaniales de Potasse d'Alsace	2,702,121
	Casting alkali metals	Ethyl Corp.	2,702,419
	Calcium hydride preparation	Metal Hydrides Inc.	2,702,740
	Recovering uranium from aqueous solutions	U. S. Atomic Energy Comm.	2,703,271
	Production of lead-free KCl	International Minerals & Chemical Corp.	2,703,272
	Magnesia products from magnesium hydroxide sludge	Food Machinery & Chemical Corp.	2,703,273
	Beneficiation of potash ores	Potash Co. of America	2,703,646
Metals and ores	Nickel foil from thermal decomposition of nickel carbonyl	Commonwealth Engineering Co. of Ohio	2,701,901
	Arc melting of zirconium	Henry L. Gilbert et al.	2,702,239
	Production of vanadium trioxide for manufacture of ductile vanadium	Westinghouse Electric Corp.	2,702,739
Organic chemicals	Production of organic sulfonic acids	Monsanto Chemicals Ltd.	2,702,273
	Producing organic fluorine cpds.	Pennsylvania Salt Mfg. Co.	2,702,306
	Biphenyl production	Monsanto Chemical Co.	2,702,307
	Azeotropic removal of hydrocarbon contaminants from phenol	California Research Corp.	2,702,784
	Amides from secondary nitro cpds.	E. I. du Pont de Nemours & Co.	2,702,801
	Preparation of phthalonitriles	Monsanto Chemical Co.	2,702,815
	Separating isophthalic and terephthalic diesters	California Research Corp.	2,702,817
	Lower dialkyl sulfides via liquid-vapor phase method	Nitroglycerin A. G.	2,702,824
	Purifying acetic acid from acetic anhydride manufacture	Eastman Kodak Co.	2,703,309
	Oxidizing liquid wastes with ozone	Welsbach Corp.	2,703,312
Resins	Protein, lignocellulose-fatty oil resin	Tata Oil Mills Co. Ltd.	2,702,754
Rubber	Alkali metal silicates as stabilizers for low temperature synthetic rubber latices	Phillips Petroleum Co.	2,702,798
Synthesis gas and products	Separation of organic oxygenated cpds. from hydrocarbons	Stanolind Oil & Gas Co.	2,702,298
	Separating mixtures of organic cpds.	Gulf Research & Development Co.	2,702,783
	Synthesis of organic cpds.	M. W. Kellogg Co.	2,702,814
Synthetic fibers	Cellulose acetate spinning process	Celanese Corp. of America	2,702,230
	Dextran filament manufacture	Commonwealth Engineering Co. of Ohio	2,702,231
	High tear strength resin-coated nylon fabric	Fabric Research Laboratories, Inc.	2,702,764
	Production—by spinning—of cellulose hydrate filaments	Societe de la Viscose Suisse	2,703,270
Waxes	Separating hydrocarbon waxes	Shell Development Co.	2,703,305



IN SURFACE COATINGS (*Paint, Varnish, Shellac*)



IN PETROLEUM (*Gasoline Additives, Lubricants*)



IN CHEMICALS (*Synthetic Fabrics and Yarns*)

Enjay assures you satisfied customers

To satisfy your customers with high quality, dependable products, specify Enjay chemicals. The Enjay Company supplies a diversified line of uniform, high quality petroleum chemicals to the surface coating, chemical and petroleum industries. Through the facilities of the *new Enjay Laboratories* you can be assured of the best application of Enjay products in your chemical needs.

PETROLEUM
PARANOX
PARATONE
PARAFLOW
PARAPOID
PARADYNE
PARATAC
PETROHOL
Methyl Ethyl Ketone
Dewaxing Aid
Ethyl Ether
Isopropyl Ether
Reference Fuels

RUBBER
ENJAY BUTYL
VISTANEX

SURFACE COATING
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Secondary Butyl Alcohol
Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Dicyclopentadiene
Ethyl Ether
Isopropyl Ether
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcoho

CHEMICAL
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
Dicyclopentadiene
Isoprene
Butadiene
Ethyl Ether
Isopropyl Ether
Tetrapropylene
Tripropylene
Aromatic Tars
Benzene
Acetone
Methyl Ethyl Ketone

ENJAY

35 successful years of leadership in serving industry

Enjay Company, Inc. • 15 West 51st St., New York 19, N. Y.
Other Offices: Akron • Boston • Chicago • Tulsa



REMOTE DIALED WEIGHT SELECTION BELONGS IN YOUR BUSINESS

THIS NEW FREE BOOK TELLS THE FULL STORY OF

RICHARDSON SELECT-O-WEIGH®

REMOTE WEIGHT SETTING SYSTEMS

Here are answers to the puzzlers you've had about completely automatic weighing, proportioning and blending. Richardson's new 28-page booklet shows in detail how industries like yours use Select-O-Weigh systems to "dial" as many as 20 individual ingredient weights in formulas.

Many industrial "case histories" and over fifty easy-to-understand diagrams and illustrations take you through Richardson's material-saving, time-saving, labor-saving story of finger-tip formulation which requires no manual changes, even for fractional proportions. Send for this free booklet today. See how a Select-O-Weigh system—developed out of Richardson's 50 years of experience in building automatic weighing, proportioning and blending equipment—can solve countless problems in your change-over from conventional weighing and proportioning methods to automation.



Write today for your free copy of Bulletin 0351.

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Cincinnati • Detroit
Houston • Memphis • Minneapolis • New York • Omaha
Philadelphia • Pittsburgh • San Francisco • Wichita • Montreal
Toronto • Havana • Mexico City • San Juan

1448

Let us put the SQUEEZE

ON HIGH EVAPORATING COSTS



. . . AND GIVE YOU ASSURED RESULTS, TOO!

Here's why Swenson evaporation costs less and produces a better product! From start to finish, Swenson offers much more than the *equipment*. An exclusive service is provided that includes preliminary product research and testing in the Swenson laboratory . . . expert engineering of evaporators that are *customed* for your particular products . . . surveillance of operating procedures and periodic checks after installation. Swenson engineers are thoroughly experienced and have helped solve evaporating problems for thousands of firms in the process industries for *65 years!* Counsel with them about multiple-effect economy . . . about long-tube evaporators . . . forced circulation . . . calandria, basket, horizontal-tube and cast-lead types.

Let them tell you about the filters, crystallizers and spray dryers that will best meet your requirements. Talk to them about *any* phase of evaporation, filtration, crystallization or spray drying and you get the practical answer to economy plus product quality. Start things off now by asking for a Swenson Catalog . . . it alone gives valuable information!

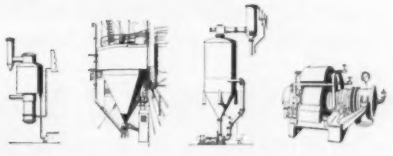
SWENSON EVAPORATOR CO.
15669 Lathrop Avenue, Harvey, Illinois

SWENSON

Proved Engineering for the Process Industries

Since 1889

A Division of WHITING Corporation



Evaporators Spray Dryers Crystallizers Filters

NEW MATERIALS OF CONSTRUCTION



New Non-Metallic Shapes Tame Tough Jobs

For the first time silicon carbide's resistance to high temperature, thermal shock, abrasion and corrosion is utilized in shapes similar to standard metal parts.

Many a chemical engineer faced with an exacting materials-of-construction requirement has eyed silicon carbide longingly—only to discover that it couldn't be fabricated in the desired shape. Conventional mixtures of silicon carbide granules and bonding agents just can't be worked into small and complicated shapes prior to firing in kiln.

What's opening industry eyes about newly-available Refrax silicon-nitride-bonded silicon carbide is the wide range of precise, intricate forms in which it can be made. Parts such as spray nozzles with internal fins; pump housings and impellers; threaded parts, bolts, nuts and tubes; agitator arms and blades; cyclone liners; thermocouple tubes; and burner tips, nozzles and blocks.

▶**Other Advantages, Too**—Outstanding among the traits of Refrax parts is the fact that most properties are retained up to, and in some cases beyond, 3,000 F. At such heat even high-temperature alloys liquefy and become useless.

Refrax parts can be formed within tolerances of ±0.005 in. They will retain their dimensions and shape even after extensive service over the indicated temperature range.

Add to this a smooth, close-grained surface texture and you have the possibility of operating moving parts at high temperature.

From moderate to extreme temperatures Refrax parts are not affected by most acids. Even corrosive slags and highly-reactive materials such as molten synthetic mica do no harm. Materials such as mixed chlorides and the sulfates of iron, zinc and tin, containing free acids, are handled without damage.

Corrosionwise, there is one point of weakness—strong alkalis.

On two other grounds Refrax outshines previous high-grade silicon-carbide refractories. One is resistance to rapid temperature changes and conditions that promote high thermal gradients. The other, improved resistance to rubbing and impingement abrasion.

▶**Checking Performance**—A recent performance report from a chemical operation shows how Refrax

What's *different* about this VALVE?



The main thing is, it was designed and built for the chemical industry by a company which has been living with the liquid-handling problems of the process field for more than 30 years.

It is not just a globe valve made of corrosion resistant materials. Construction features are based on what we know happens in chemical plants. Like LaBour Pumps, LaBour Valves are built for *dependable* service—the lowest cost service you can buy.

Ask for your copy of Bulletin H-2.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR VALVES

THE LABOUR COMPANY, INC. ★ ELKHART, INDIANA, U.S.A.

Newsworthy Equipment This Month

Equipment Cost Indexes, p. 282

New Materials of Construction
Silicon Carbide Shapes 274A
Clad Metals 276A

New Processing Equipment
Heat Transfer Machine 278A
Small Filter 278B
Reflux Head 278C
Agitator Drive 280A
Pipe Line Sampler 280B
Agitator 280C
Pilot Pressure Filter 280D

New Heating & Cooling Equipment
Evaporative Condenser 282A
Transfer System 282B
Fin-Tube Exchangers 282C
Slide Damper 282D
Drum Dryer 282E

New Instruments & Controls
Portable Oxygen Analyzer 284A
Thermocouple Converter 284B
Flow Meter 284C
Control Systems 284D
Scanner 284E

New Fluids Handling Equipment
Stainless Fittings 286A
Nylon Tubing 286B
Canned Motor Pump 286C
Plastic Pipe and Fittings 286D

New Maintenance Tools & Supplies
Tube Bundle Pusher 288A
Drum Reroller 288B
Portable Telephone 288C
Welding System 288D
Field Valve Service 288E

New Electrical & Mechanical Equipment
Backspin Ratchet 290A
Power Engine 290B
Lighting System 290C
Silver-Plated Fuses 290D
Lubricated Seals 290E

Page number is also Reader Service code number

For more details, use Reader Service Card

nozzles stand up on a severe chemical application. Nozzles are used for spraying hydrofluosilicic acid containing precipitated silica.

A tangential inlet at right angles to the outlet has a female thread for connecting directly to the supply pipe. Generally, male threads are preferred on Refrax parts being connected to metal because the coefficient of expansion is only ½ that of steel. However, in this particular application temperature variation is not sufficient to cause trouble.

After four months handling acid at 156 F the Refrax nozzle showed essentially no wear. Life of previous alloy bronze nozzle was three weeks.

▶ **Basic Difference**—Silicon carbide granules in Refrax are held together by a near-metallic type of bond rather than the siliceous bonding agents normally employed. In the older types the bond is physical; the particles are locked together by fused films of bonding agent.

In Refrax the bonding agents actually undergo a chemical transformation during the firing operation. The original bonding material combines with the atmosphere to form a tough bond of a different chemical composition.

A measure of this toughness is the 5,600-psi. modulus of rupture at 750 C, 3,600 psi. more than regular-bonded silicon carbide; and a tensile strength of 3,000-3,500 psi. at 25 C.—**The Carborundum Co., Refractories Div., Perth Amboy, N. J.** 274A

Clad Metals

Made by new process, now available in wide range of materials.

A wide variety of clad metals for industrial use now is being fabricated by a new high vacuum brazing method. Among the claddings available are nickel-base steel alloys such as chromium, chromium-nickel, and nickel; Monel, Inconel, Hastelloys and silver.

Advantages listed for Hortonclad are an integral and continuous bonded cladding of uniform thickness, and a selection of cladding metals not available by other methods. Vessels using Hortonclad have withstood severe corrosion conditions in the chemical, petroleum and paper industries for several years. No ill effects have been observed where process temperature has cycled from ambient to 900 F.

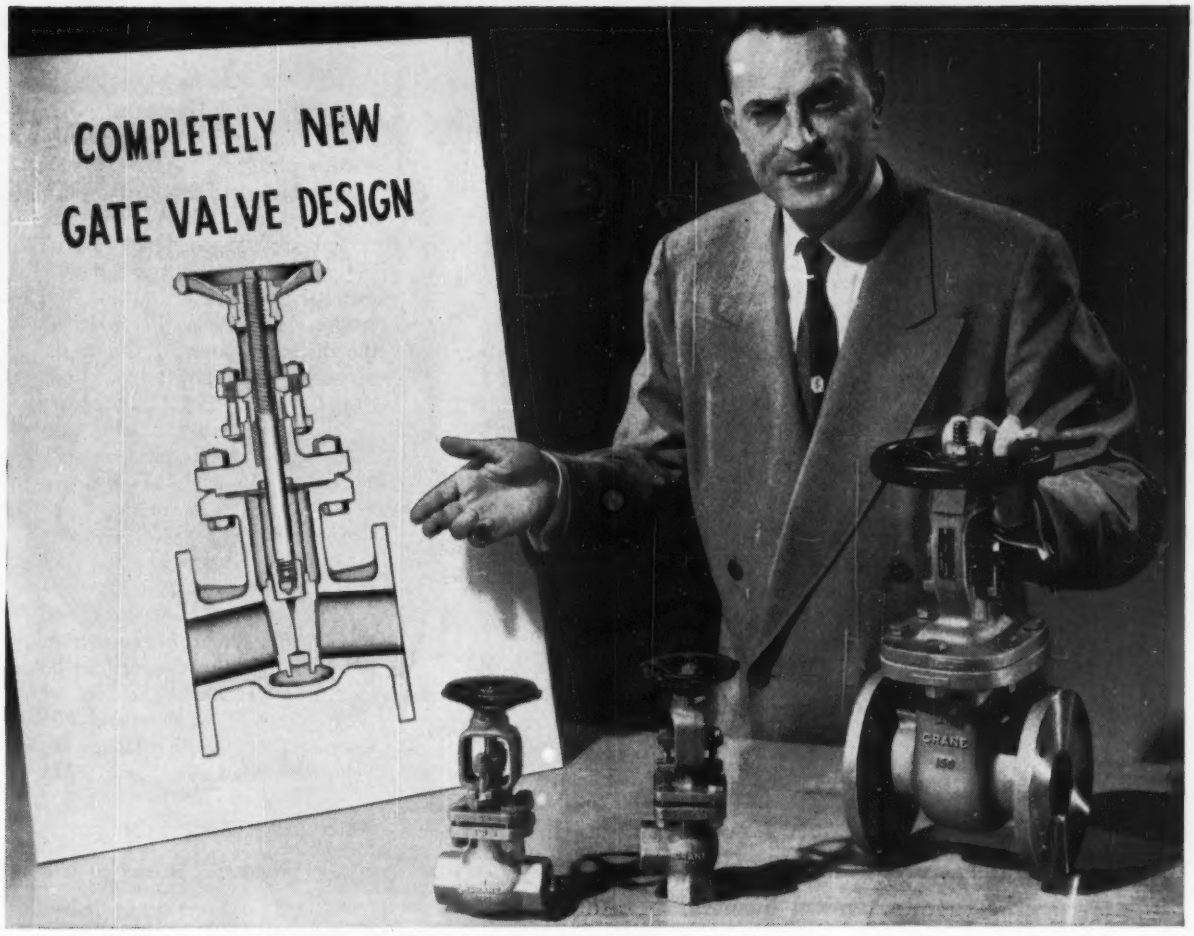
Hortonclad plates are produced by heating an assembly of base metal, brazing material and cladding metal under high vacuum. The brazing material serves as a barrier preventing carbon migration from the base plate to the clad surface. Since no rolling is required, thickness of cladding is uniform and a wide variety of metals may be clad.

The brazed bond is a high-strength joint which meets all applicable code requirements. Hortonclad can be worked readily by usual methods such as rolling, bending, welding and pressing.—**Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill.** 276A

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



New CRANE Corrosion-resistant valves in 18-8 SMo and Craneloy 20

Gate, Globe, Angle and Check Patterns

Few valves for process industries have ever received the quality treatment given this new Crane line—at prices you'll find O.K.

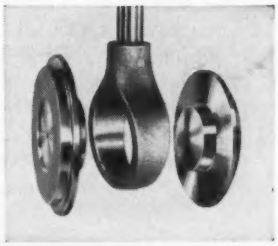
Note, for instance, the unique yet simple split-wedge disc construction in the gate valves. Those dual identical discs are free to rotate in their holder—the most effective design for resisting galling. The trunnion shape at the back of each disc assures even distribution of closing forces. You couldn't buckle them if you tried.

The globe and angle valves give equally outstanding control of corrosive fluids. A new type disc-stem connection, with minimum clearances, practically eliminates vibration. By placing seating load closer to seats, it provides easier, more accurate closure.

Check valves feature compact, thoroughly proved, non-slamming design.

Throughout, these valves are built for better service in your choice of Crane 18-8 SMo Stainless Steel or Craneloy 20. Both lines come with screwed or flanged ends.

ASK FOR THIS CATALOG—Full information including service suggestions given in circular AD-2080—available from your Crane Representative or by mail. Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers everywhere.



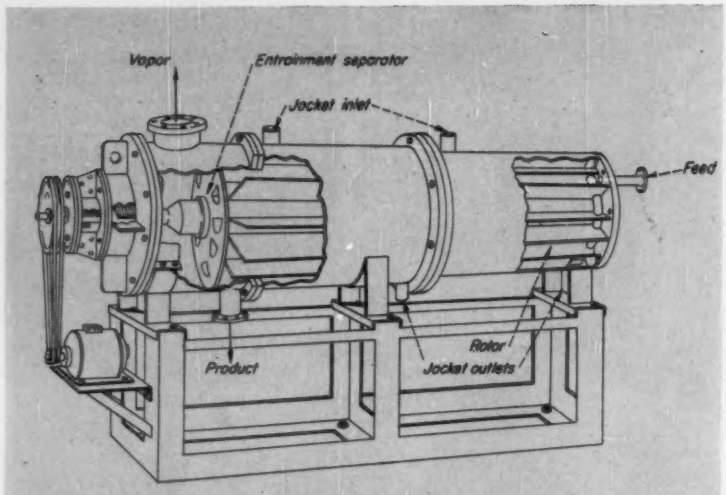
New split-wedge disc in gate valves combines the benefits of free rotation with uniform seat load pressure.

for the THRIFTY BUYER

CRANE CO.

VALVES · FITTINGS · PIPE
KITCHENS · PLUMBING · HEATING

CRANE'S FIRST CENTURY...1855-1955



Rotor Spreads Liquor Thin to . . .

Vary Film in Thermal Process

Centrifugal heat transfer machine adjusts to vary film thickness for optimum results. Unit works under pressure or vacuum and at high temperatures.

Processing involving the transfer of heat can be done with films adjusted to optimum thickness using the Ajust-O-Film machine. With this centrifugal, thin-film unit extremely heat-sensitive materials can be concentrated rapidly to high solids content. High viscosity can be handled readily without impairing the end result.

The horizontal Ajust-O-Film unit is suited not only for concentrating but also for carrying out chemical reactions, stream stripping, degassing, distilling, pasteurization, etc. It operates continuously and automatically under either vacuum or gas pressure, and when desired at high temperature.

At times, this machine is operated as a cooler merely by circulating coolant through the jacket. Products that foam and entrain are kept under control by centrifugal action within the unit and an effective entrainment separator.

▶ **Whirling Blades**—Unit consists essentially of a cylindrical, horizontally-mounted jacketed chamber. Inside the chamber is a rotor.

Rotor and chamber have matched tapers. Axial adjustment of rotor position varies clearance between vane tips and chamber wall. Machines can be built to give clearances from paper thin to ½ in.

Incoming feed is metered or pumped into the evacuated or pressurized chamber. It is immediately picked up by the revolving rotor blades and whirled against the heated or cooled chamber wall. Rotor action imparts high turbulence.

▶ **Direction of Flow**—General practice is to feed into the small-bore end of the chamber. A component of centrifugal force moves the material toward the larger diameter in this "downhill" type of operation. Finished product drops into the outlet pipe.

Vapor produced flows in the same direction as the product, then out through the centrifugal entrainment separator to the exhaust. For special applications, such as gas stripping or deodorization with steam, the vapor may flow countercurrently.

Some materials, because they lack body or for some other reason, must be fed into the large-bore end of the machine. An actual pool of material is maintained within the machine, extending all the way to the discharge point at the small-diameter end. Hydrostatic head then becomes a factor in controlling throughput rate. As fast as feed enters it displaces an equal amount of product from the discharge end.

Rotor speed can be varied, to give optimum results. Normal speed for a 24-in. diameter unit is 350 rpm.

Ajust-O-Film is built in sizes to handle throughputs ranging from 100 to 5,000 lb. per hr. It can be fabricated of steel or choice of corrosion-resistant materials.—**The Kontro Co., North Main St., Petersham, Mass.** 278A

Small Filter

High capacity is easy to service.

Using either a completely new stainless-steel cloth-bag element or porous stone the Sel-Rex Little Giant filter is said to give continuous capacity in the range of 800 gph.

Unit is compact and easy to service; can be cleaned completely in less than 15 min.

The Little Giant filter has a 32-in. dia. at the base and requires only 50 in. of head room. All working parts are suspended beneath the tank to protect them from dirt and drippings.—**Bart-Messing Corp., 229 Main St., Belleville 9, N. J.** 278B

Reflux Head

Controls ratio accurately under severe conditions.

A new, complete line of electrically-operated automatic reflux heads give accurate, day-in, day-out performance. Ratio control is not affected by changes in boil-up rate or by heat losses in the head under all conditions of distillation. Units



"International" MIXERS

Tailored for the job–

But Basically Designed for Contingent Modification

After all, it's PERFORMANCE that counts. Engineers agree that efficiency comes first in profitable operation, and a Mixing unit designed for the purpose at hand (with adaptability to similar operations) will deliver superior performance and optimum results. INTERNATIONAL Mixing and Processing Equipment is preferred by Engineers because they know it is made and Guaranteed for a specific purpose—to do it better and at less cost. It's adaptability to other similar operations is an extra advantage to the user, where modification due to normal process changes become necessary. Motors, Gear Ratios, Shafts and Shaft Diameters as well as Turbine Elements are of course, interchangeable within normal limits, at minimum time and expense.

Wherever you find INTERNATIONAL Equipment you'll find a pleased user—and you'll find it in practically every segment of the Chemical, Pharmaceutical, Ceramic, Industrial and Petroleum industries. Remember to investigate "INTERNATIONAL" when you want Guaranteed Performance.

Type LFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Type GFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Courtesy, International Minerals & Chemical Corp., Bartow, Fla.

Weldforged Grating by Kerrigan Iron Works

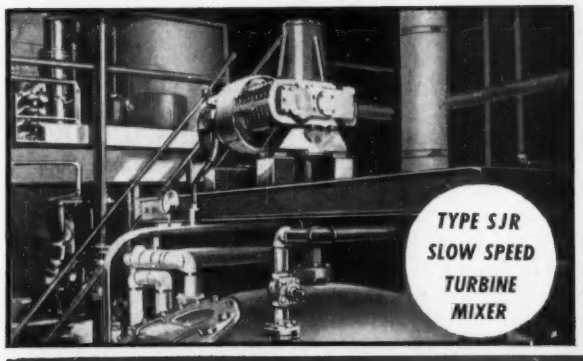
INTERNATIONAL ENGINEERING, INC.
DAYTON 1, OHIO

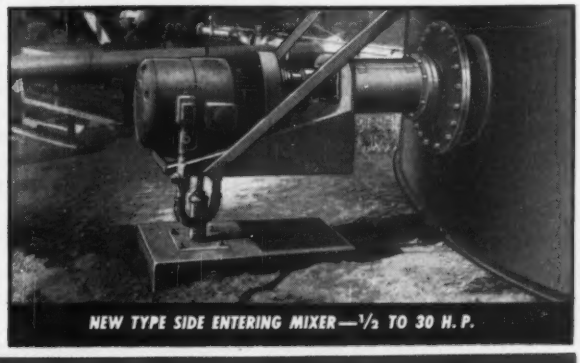
New York • 15 Park Row • WOrth 2-2580
Chicago • 507 S. Dearborn • WAbash 2-0723

TECHNICAL BULLETINS AVAILABLE

In the interest of intelligent Engineering Cooperation, INTERNATIONAL issues Technical Bulletins on the various phases of Mixing and Processing, which will be gladly sent on request. Simply indicate the subjects in which you are interested.

Top Entering Mixers and Agitators	73-76
Side Entering Mixers and Agitators	72-A
Dry Blenders and Ribbon Mixers	78
Grinding and Mulling Fans	5-A
Portable Mixers	74-A
Mixing and Extruding Machinery	62-A
Ball and Pebble Mills	100
Continuous Mixers	A
Stack Fans and Duct Boosters	109-A
Laboratory and Pilot Plant Equipment	77-A





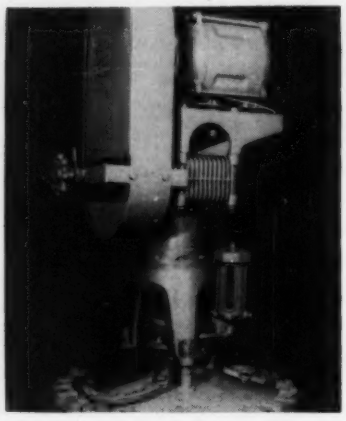
NEW TYPE SIDE ENTERING MIXER—½ TO 30 H. P.

are now operating commercially under severe conditions of high vacuum, high temperature and corrosive service.

Heads are equipped with tilting funnels to split accurately the liquid flow. They have an adjustable mechanism that operates in corrosion-resistant, self-lubricating bearings.

Unit is controlled from an inexpensive timer located conveniently on the control panel. It can be set instantly for reflux ratios from 0.1:1 to 100:1 and will maintain set ratio even though distillation conditions vary.

Heads can be used with various types of condensers. Sizes range from 2 to 36-in. dia.—**Distillation Engineering Co., 105 Dorsa Ave., Livingston, N. J.** 278C



Agitator Drive

Built for efficient operation on reactors up to 100 gal.

Reactors up to 100 gal. size generally process small quantities of many different materials. That's the type of work for which the new PW drive is designed.

Agitator speed can be varied easily either with various combinations of constant speed V-belt sheaves or with variable pitch sheaves. Gear and worm of the speed reducer are both "throated" to provide larger contact area per tooth and more teeth in contact. Throated gear teeth and worms have convex arc shapes which mesh to give full-depth contact.

Gear housing is smaller than used previously. Furthermore, the motor is mounted above the drive instead of on the side. This makes operation of the vessel and connection of supply lines more convenient.—**The Pfaudler Co., Rochester 4, N. Y.** 280A

Pipe Line Sampler

Takes representative composite of flow through system.

A new automatic pipe-line sampler takes minute samples at close intervals (up to 300 per min.) to produce composite samples representative of constituent flow. It can handle liquids over a wide viscosity range and is not affected by changes in liquid viscosity or specific gravity. Sampling rate and volume can be varied.

Sampler can be supplied with control proportional either to time or flow. Pressures up to 350 psi. and temperatures to 200 F can be handled by standard models. Special models can be furnished for higher pressures and 350 F.

There is no motor or mechanical switches. Sampler is a low-capacity piston pump, operated magnetically and controlled by a simple electronic circuit. Operating on 20 to 300 cycles per min. the pump can deliver from ¼ to 4½ gal. in 24 hr.—**Gilbert & Barker Mfg., Co., West Springfield, Mass.** 280B

Agitator

Standard, low-cost unit for wide range of mixing jobs.

Liquids up to 2,000 centipoises viscosity and products containing semi-solids are handled with ease by the Unimixer agitator. Available in sizes 1 through 5 hp. the Unimixer mixes, stirs, blends, dissolves, aerates and suspends; can thin, color and tint and help absorption of gases.

Pedestal and drive are integral. Drives can be geared or direct with choice of centripoise propellers or multi-purpose turbines. Lower anti-friction bearing can be interchanged easily with a combination pressure-type stuffing box with oil-less bronze bearing.

Output shaft is extra heavy to take care of side thrust and bending stresses. Oil leakage around shaft has been eliminated positively.—**The Patterson Foundry & & Machine Co., East Liverpool, Ohio.** 280C



Pilot Pressure Filter

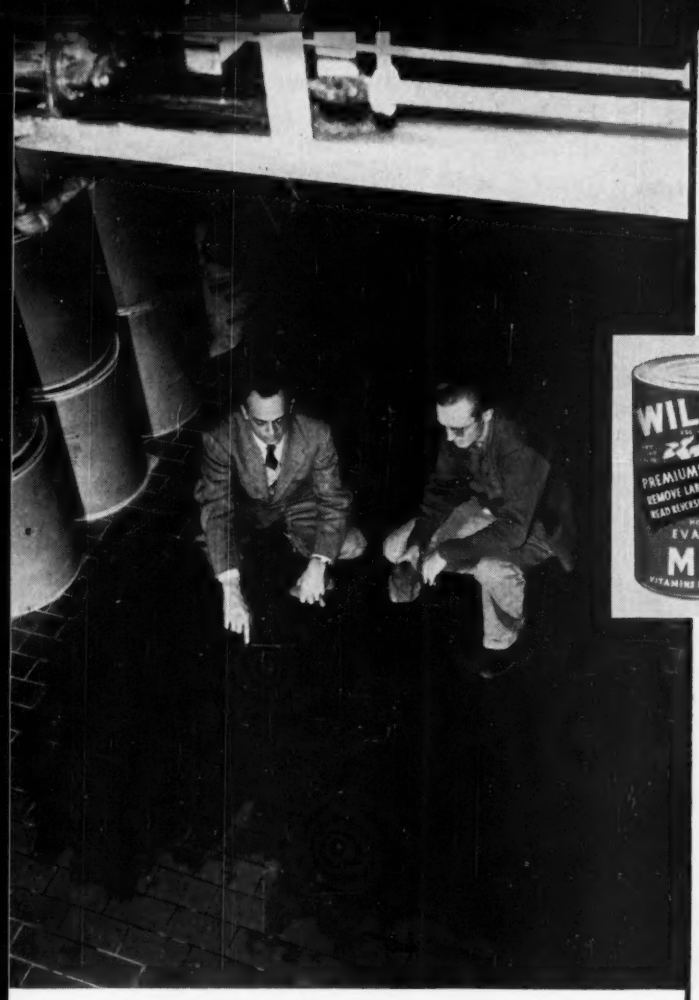
Aids in selection of correct production filter.

The new Pronto-Junior miniature pressure filter was designed to help you select the proper filter for production requirements. It will give specific rates, and variation of flow rate as a function of the differential filtering pressure and the throughput. Cake density and washing efficiency can be determined also.

Unit is designed for precoat filtration but can be used also for evaluation of filtration fabrics. Unique design permits use of one, two and three vertical filter leaves. With three identical leaves, spaced at 1½-in. centers, net filtering area is 1 sq. ft. Leaves are covered with 24 x 110 Dutch weave metal cloth.

Filter is constructed of stainless steel for a maximum working pressure of 80 psi. All major pipe connections are arranged in the base plate so that the unit can be disassembled quickly by removing the four nuts from the tie rods. Filter has an over-all height of approximately 16 in. and a shell diameter of 6½ in.—**American Plant Equipment Co., 220 Fifth Ave., New York 1, N. Y.** 280D

STANODRIP *Oil whips lubrication problem at Wilson Milk Company*





MANAGEMENT OF THE Wilson Milk Company plant, Sheridan, Indiana, had a serious lubrication problem. STANODRIP Oil solved it.

In overhead bin loaders, hydraulic rams push powdered milk along conveyor chute to weighing machine. Leakage of lubricant from rams on the floor below caused a sanitary and safety problem. Packings were replaced every two months but leakage often recurred as early as two weeks after packing replacement.

Then Mr. Taylor Wiham, Assistant Superintendent, called in John Pirtle, Standard Oil Industrial lubrication specialist. Mr. Wiham asked about STANODRIP Oil and its possible use as a solution to this lubrication problem. Decision was made to convert to STANODRIP Oil No. 29. Old oil was removed, packings replaced and STANODRIP installed.

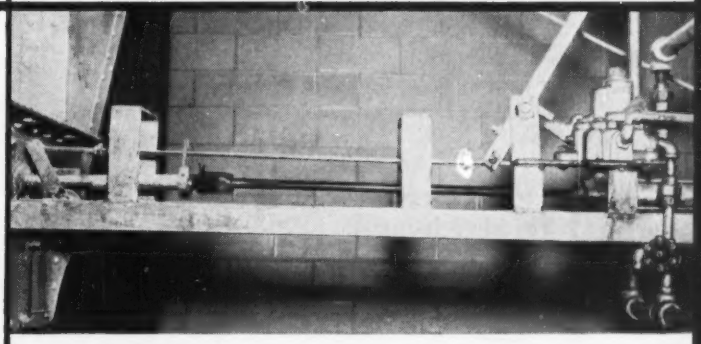
In more than 8 months since installation of STANODRIP Oil, there has been no leakage, no packing replacement. Hydraulic rams are lubricated without oil dripping or creeping.

Maybe STANODRIP Oil can serve you as it has Wilson Milk Company. Find out. In the Midwest, call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

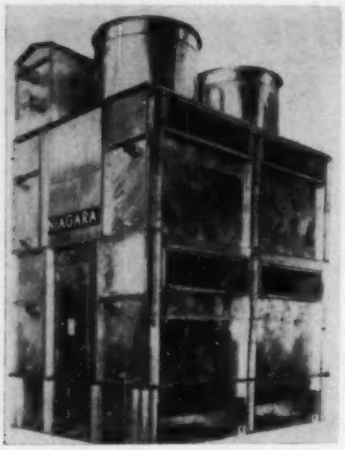
Taylor Wiham, Wilson Milk Company (right), and John Pirtle, Standard Oil lubrication specialist, inspect oil stain on otherwise spotless floor, the result of previous oil leakage from overhead hydraulic bin loader. Leakage has been eliminated through use of STANODRIP Oil No. 29. Helping customers with lubrication problems is something John Pirtle is well equipped for. John has an engineering degree from Rose Polytechnic Institute, has completed Standard Sales Engineering School and has a number of years of field technical service experience. Customers find this experience and training pay off *for them.*

STANDARD

STANDARD OIL COMPANY
(Indiana)



Three bin loaders like the one shown here dripped oil until converted to STANODRIP. No leaks have occurred in 8 months since. Previously, packings were replaced every two months. Even then leakage often recurred as early as two weeks after repacking.



Evaporative Condenser

Handles large capacity with low water consumption.

A new ammonia condenser with 200-ton refrigeration capacity is said to consume less than 5% of the water used by submerged coil condensers with equal capacity.

Condenser operates by evaporating sprayed water from the surface of condensing coils through which the refrigerant gas passes. A pre-cooling coil removes the superheat from the refrigerant gas bringing it close to the condensing temperature before it enters the sprayed condensing section. Scale deposits are avoided thereby.

Also in the gas line, between the precooler and the condensing coil is a trap for removing condensed oil vapor.

The air stream entering at the top of the condensing section is drawn downward through the water sprays, over the coils, then upward to be exhausted through propeller fans at the top. Reverse direction air flow is said to increase unit capacity and greatly reduce the outlay for electric power.–**Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.** 282A

For More Information . . .



about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

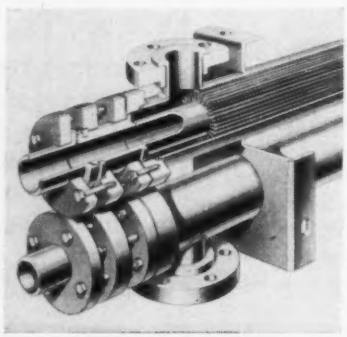
Transfer System

Heats by circulating hot oil, furnished as package.

High liquid temperatures over a wide range are obtained with a new low-cost, low-pressure, packaged heating system. Chemically stable heat transfer oils are heated automatically by electricity and circulated at any desired temperature up to a maximum in the range of 600 F.

Five standard systems are available with heat outputs up to 50 kw. Illustrating the features, the 18-kw. unit has a temperature range of 200 to 600 F with control limit on oil temperature of ±2°F. There are three independent 6-kw. heating units controlled automatically. At 550 F oil circulates at 25 gpm. and 75 ft. head.

Normal operation is confirmed by the action of pilot lights and gages. Relief valves and safety switches provide protection.–**The Whitlock Mfg. Co., West Hartford 10, Conn.** 282B



Fin-Tube Exchangers

Built for heavy-duty corrosive service.

Making use of a new method of heliarc welding longitudinal fins to tubes, a new line of fin-tube exchangers is built especially for service where corrosion or contamination are factors.

Exchangers use the new-type fin tubes in a double-pipe arrangement. They are designed to give exceptional service where the conventional bare-tube heat exchanger is unsuited, or where one fluid has an appreciably higher resistance to exchange of heat than does the other one.

The new exchanger is highly adaptable to changing load requirements and changes of duty within a given plant. Tubes from individual units may be withdrawn without displacing the connecting pipe, even when units are installed in banks with interconnecting piping. Removal is made possible by eliminating the split ring at the tube-to-shell joint.–**American Locomotive Co., Schenectady 5, N. Y.** 282C

Slide damper for automatic flue control can withstand temperatures up to 3,000 F. Made of silicon carbide it is replacing conventional fire clay dampers and outlasting them several times. It is not subject to cracking under thermal differentials when flue is partly open.–**Electro Refractories & Abrasives Corp., 355 Delaware Ave., Buffalo 2, N. Y.** 282D

Single drum dryer for glue and gelatin dries product quickly forming a heavy, dense product. Variable drum speed and temperature controls allow glue of desired quality to be produced without degradation. – **Buflovak Equipment Div., Blaw-Knox Co., Pittsburgh, Pa.** 282E

Equipment Cost Indexes

	Dec. 1954	March 1955
Industry		
Avg. of all	184.2	186.2
Process Industries		
Cement mfg.	177.1	178.4
Chemical	185.7	187.1
Clay products	171.9	173.2
Glass mfg.	175.5	176.8
Paint mfg.	178.8	180.1
Paper mfg.	179.1	180.4
Petroleum ind.	182.3	183.7
Rubber ind.	184.7	186.1
Process ind. avg.	182.8	184.2
Related Industries		
Elec. power equip.	187.5	188.9
Mining, milling	186.6	188.0
Refrigerating	204.1	206.8
Steam power	175.0	176.3

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1955, pp. 178-9 for annual averages since 1913.



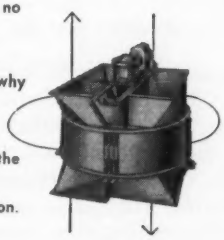
reduce slag

stay on stream at top capacity months longer with the Ljungstrom® Air Preheater

HOW FAST IS "WRITE OFF"?

By cutting turnaround time alone, the Ljungstrom means major savings for you. When you take the other Ljungstrom advantages into account—up to 20% fuel saving . . . more economical furnace design, with no need for convection surfaces . . . burns many fuels you used to throw away . . . consistently higher through-put . . . higher product quality—you can see why a Ljungstrom is paid out in just a few months.

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write The Air Preheater Corporation.



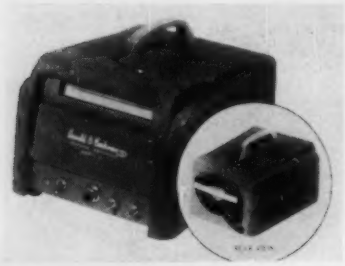
Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

Slag—primary cause of reduced capacity—can be substantially reduced by the Ljungstrom Air Preheater.

That's because preheated air mixes more thoroughly with fuel. The result is better combustion . . . and less slag-forming material present in the furnace. Oil tubes stay cleaner . . . stills stay on stream at top capacity for months longer. As an example, one pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom and modern high-temperature burners, the still operates continuously at 18,000/20,000 barrels.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



Portable Analyzer

Measures oxygen quickly, simply and accurately.

Completely portable for use in the field, plant or laboratory Model C2P oxygen analyzer measures flowing samples or fixed volumes as small as 3 cc. Instrument operates on the principle of paramagnetism to measure oxygen directly by physical means.

Response is rapid–95% response to final reading within 40 sec. on standard models, or within 7 sec. on special models. Scale reads directly and may be calibrated either in percent oxygen or mm. of Hg. partial pressure.

Ranges of 5% or more can be furnished between 0-75% oxygen, and in ranges of 15% or more between 75-100% oxygen. Accuracy is within ±1% of full scale.–**Arnold O. Beckman, Inc., 1020 Mission St., South Pasadena, Calif.** 284A

Infrared Analyzer

Can be operated with a pneumatic recorder-controller.

Liston-Becker's standard Model 21 plant steam analyzer now can be modified to provide a direct pneumatic signal of high accuracy to operate recorders, controllers or pressure gages. Demand for such modification arises from hazardous operations and where graphic panels make small pneumatic recorders essential.

Output from a Standard Model 21 analyzer controls an electrical-to-air transducer. Output of the transducer controls a pneumatically driven wedge in one of the optical beams and also operates the pneumatic recorder.

In most cases, use of the less expensive pneumatic recorder offsets increased installation costs and the accessory equipment necessary for this type of operation. Chief disadvantage of pneumatic operation is a fixed range determined by the constant of the pneumatic bellows and the shape of the optical wedge. **Liston-Becker Instrument Co., Inc., 649 Hope St., Springdale, Conn.** 284B

Flow Meter

With explosion-proof switch for hazardous atmospheres.

Meters for measuring predetermined quantities of liquid now are available for service in hazardous atmospheres. The new explosion-proof Electricontact meter consists of a standard Niagara meter plus a register containing an electric switch. It is designed to complete an electric circuit after a predetermined quantity of liquid has passed through the meter.

The explosion-proof construction is available on the four basic groups of Niagara meters: for cold water and water-base liquids; heated water and water-base liquids; oils and solvents; and corrosive chemicals.

After the meter is completely assembled and connected electrically the switch closing points can be adjusted through an access plate on the rear of the register.–**Buffalo Meter Co., 2893 Main St., Buffalo 14, N. Y.** 284C

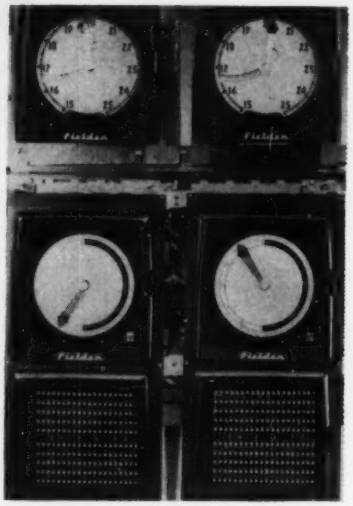
Control Systems

Replace relay systems to improve reliability and life.

A more reliable tool for automatic control engineers was unveiled recently with introduction of the Cypak system. These static switching circuits are intended as replacements for relay systems. Since they utilize transistors and magnetic amplifiers they have no moving parts, are claimed highly reliable.

Cypak systems are, in a general sense, switching systems that are essentially digital. However, they can be combined with analog systems where the control problem warrants it.

Although new, Cypak systems are fully competitive with relay systems and can be expected to become even cheaper with further improvements. They respond faster and run at very low power levels.–**Westinghouse Electric Corp., Pittsburgh, Pa.** 284D



Scanner

Repeatedly checks a number of process steps.

A new indicating scanner monitors a variety of process variables involving level, temperature, thickness, mechanical movements, tolerances, weight and pressure. It will keep a steady check on six, 12, 24, 48 and more steps in a manufacturing process, it is said.

When a point being checked strays beyond the preset control zone the scanning stops at that point and actuates an alarm or flashes a signal. The indicator dial shows the extent of the deviation. Associated control systems may correct the condition.

In cut above, units at top indicate temperature at each step in process as it comes under control. Units in middle tell which step is being controlled. At the bottom a bypass connection can be made through the sliding connectors shown in the case.–**Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 North Fourth St., Philadelphia 33, Pa.** 284E

Hardened, Honed Seats

for tough throttling service

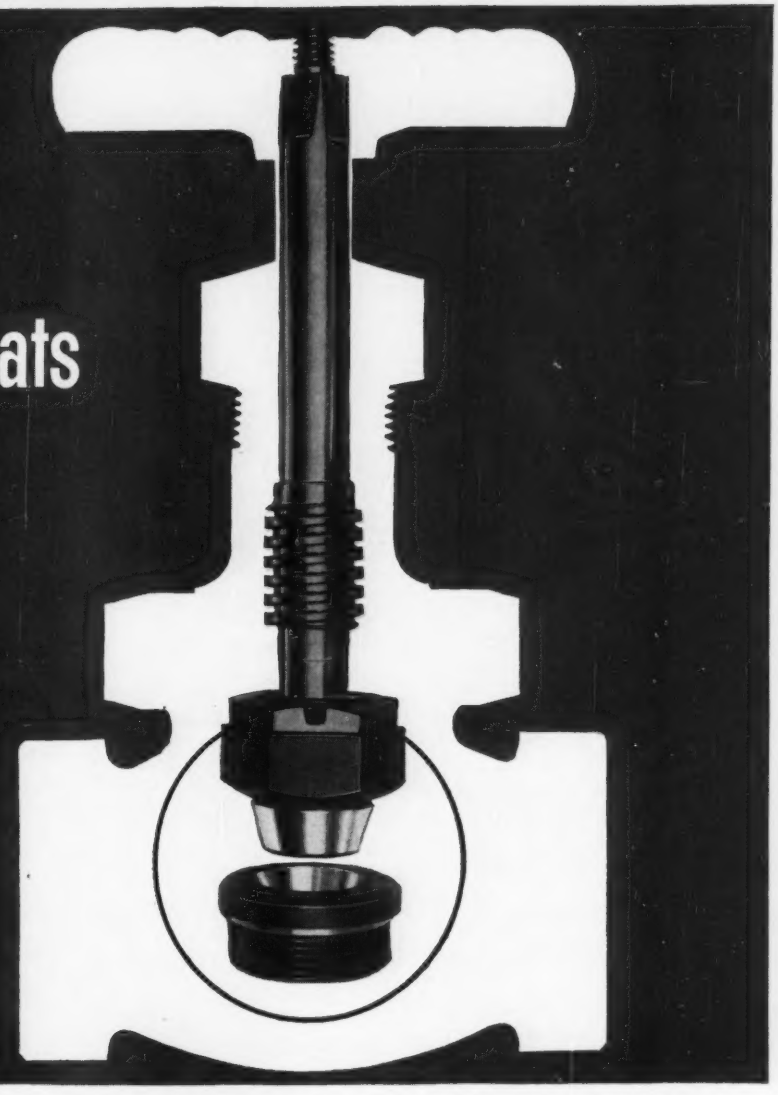


Fig. No. 558, bronze globe valve, 200 lbs. WSP, @ 550°F., 400 lbs. WOG, non-shock

A plug-disc and seat so hard they can crush scale between them and still close tight. A stem that absolutely will not gall or seize. The combination is in a rugged bronze valve designed for tough throttling service . . . the OIC 558!

Both plug-disc and seat are stainless steel, heat-treated to more than 500 Brinell hardness. Their seating surfaces are ground and *honed* to an accurate, smooth, bearing finish. The stem is OIC *alloy-40*, a sturdy bronze which won't gall or seize.

Remember, in throttling service a valve's stem, plug-disc and seat must withstand the most abusive wear. Rely on the toughness designed into this OIC line to give you extra-long service. Specify the modern 558 where you need bronze globe valves for throttling.

Write for Form No. 1001 which describes this valve along with the entire OIC 500 line, including composition disc and spherical disc globes, angles and check valves.

Call your OIC Distributor.



THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES**

Stainless Fittings

In a wide range of sizes are low cost.

Chemical plants having need for quick assembly and disassembly of light stainless-steel pipelines will find these new low-cost, stainless-steel fittings and couplings of interest.

Available either in type 304 or 316 stainless steel these fittings have flared sleeves. Connections are made with triple sealing gaskets and pressed mild-steel channel-type flanges with bolts. Only the sleeve and the neoprene rubber in the gaskets contact the fluid in the pipe. No welding or precision pipe fitting is required.

Construction of coupling allows for deflection, misalignment, expansion and contraction between two joined pipes while maintaining 500 to 1,000 psi. hydrostatic pressures. Tees, elbows, crosses and reducers are made in all sizes from ¾ to 12 in.—**R. H. Baker & Co., Inc., 2070 East Slauson Ave., Huntington Park, Calif.** 286A

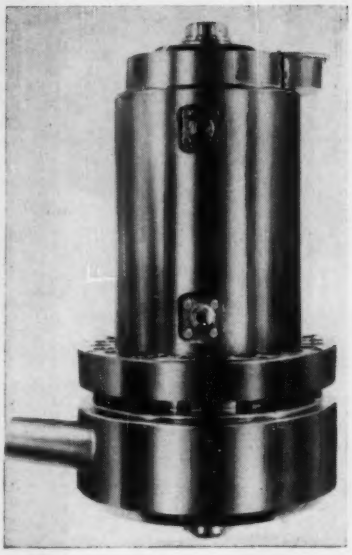
Nylon Tubing

Is flexible, tough and tested for 2,500 psi. bursting pressure.

Tubing fabricated of nylon now is available for handling air, gas or liquid flows. It is particularly adaptable to lubricant, hydraulic, fuel, oil and coolant lines. Also, it is suited for process lines handling chemicals and solvents.

Nylaflow tubing flexs without fatigue, can withstand vibration. It is unaffected by oil, gasoline and greases, will resist chemicals with the exception of formic acid and concentrated mineral acids or phenol. Also, it does not abrade and is thoroughly resilient. Under steady use Nylaflow must be protected from exposure to sunlight and prolonged temperatures over 180 F.

Tubing is available in O. D. sizes from ⅛ to ¾ in. with coil length varying from 100 to 500 ft. Special sizes may be furnished on request.—**The Polymer Corp. of Pa., Reading, Pa.** 286B



Canned Motor Pumps

Have zero leakage over wide range of temperature and pressure.

Designed originally to circulate water between nuclear reactor and steam generator the Westinghouse line of hermetically-sealed motor pumps is now available for other industrial uses.

These units will handle radioactive water with zero leakage at rates from 5 to 17,000 gpm. They can pump water and many other fluids at system pressures up to 2,500 psi. and temperatures as high as 650 F.

Special designs handle liquid metal at system temperatures as high as 1,000 F. They also can be designed for system pressures up to 10,000 psi.

There are no external shaft seals in these pumps. Suction and discharge nozzles can be welded into the pipeline. System fluid fills the motor cavity, but is excluded from the rotor and the stator windings by sealing jackets in the magnetic gap. All parts contacting the fluid are made of corrosion-resistant alloys.—**Westinghouse Electric Co., P. O. Box 2099, Pittsburgh 30, Pa.** 286C



Plastic Pipe and Fittings Installed Throughout Plant

Installation of 2-in. polyvinyl chloride intake line on sulfuric acid storage tank marks one step in complete changeover from metal to plastic pipe and fittings at Globe Chemical Co., Cincinnati. Globe, a major distributor of acids, solvents and chemical compounds, uses piping to convey mainly 77-96% sulfuric acid, 61.4% nitric acid, 37-38.5% muriatic acid, 75-85% phosphoric acid and 99½% glacial acetic acid. Temperature is ambient and pressures do not exceed 100 psi.—Tube Turns Plastics, Inc., 224 East Broadway, Louisville 1, Ky. 286D



NEITHER STORM NOR HEAT NOR CORROSION knocks out ANACONDA's 3-conductor 15kv self-supporting Aerial Cable—shown here at Shell Oil's modern new refinery at Norco, La.

GO UP TO BRING COSTS DOWN

—with AnacondA Aerial Cable

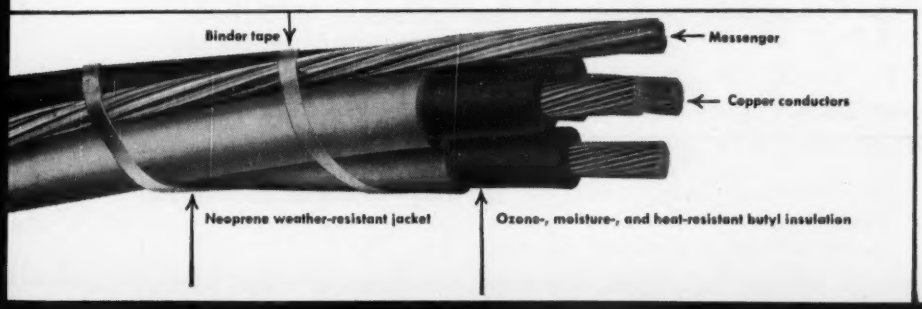
When new power is needed or when old circuits must be replaced quickly and at low cost—more and more plants are turning to ANACONDA Aerial Cable.

In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult. This cable solves the problem.

It's fast, easy to install—particularly in crowded areas. No special ducts or crossarms or insulators are needed. Even in open areas, this rugged, neoprene-jacketed cable costs much less than buried systems.

You can see that it is neat. It is equally safe . . . and reliable!

Today's finest aerial cable! Type AB butyl insulation gives ANACONDA Aerial Cable the finest performance record. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 55979



Ask the Man from

ANACONDA®

about your

High-voltage Aerial Cable

Tube Bundle Pusher

Eliminates need for erecting steel supports during bundle removal.

A new hydraulic handling device removes and replaces heat exchanger bundle tubes without need for "jerry-built" rigging and pulling beams. Also, it reduces the usual safety hazards. Two men can push a bundle eight feet in less than 25 min.

The hydro-ejector attaches directly to the exchanger shell. None of the pushing force is transmitted to the exchanger supports. So accurate is the alignment that even the largest bundles will not stick when moved rapidly by the 12,000 lb. force exerted by the device.

Hydro-ejector comes as a packaged unit ready for instant operation. It includes the pump, hose, adjustable yoke, ram, tie rods, cable and all other accessory equipment.—**The Fabricated Products Div., M. W. Kellogg Co., 225 Broadway, New York, N. Y.** 288A

Drum Reroller

Reconditions drums.

With a newly-available drum rerolling machine all dents, wrinkles and irregularities can be rolled out of 30 and 55 gal. drums. The machine handles both sizes without resetting or changing parts.

Rollers conform to the 30-gal. size. Body rolling and hoop rolling operations are separate.

There are two sets of rollers powered by one common drive. Each roller has separate control.

Although drums are handled twice this is offset by a fast and thorough straightening job. It is only necessary to position the drum twice on each set of rollers.—**Drum Equipment Corp., 947 Lehigh Ave., Union, N. J.** 288B

Portable Telephone

Powered by voice.

Dependent only on the voice for power a completely portable telephone unit is ready for service instantly at any time. Complete Communipak package includes a lightweight, heavy duty cable reel holding 250 ft. of cable and two sound-powered telephone handsets.

All parts and components of the equipment are standard commercial telephone quality; telephone parts are moisture and corrosion resistant. Heavy duty slip-ring connections provide for two-way conversation even while cable is being unreeled. —**The Wheeler Insulated Wire Co., Waterbury, Conn.** 288C

Welding System

For chrome-moly steels.

A new arc welding system using premium electrodes is being offered for fabrication of chromium-molybdenum alloy steels in high-pressure, high temperature piping and equipment. Advantages claimed are: weld cracking is almost eliminated, extremely high preheat temperatures can be avoided, not necessary to maintain preheat after welding and prior to stress relieving, and in many cases it obviates need for stress relieving provided applicable codes are not violated.

Murex croloy electrodes have controlled low carbon content to assure more ductile weldments. Lime coating on the electrode keeps spatter losses at an unusually low level to promote stable arc action.

Electrodes are available in four types: 1A, 2A, 2¼A and 5A. The designations indicate the approximate percentages of chromium found in the weld deposit analysis. —**Metal & Thermit Corp., 100 East 42nd St., New York 17, N. Y.** 288D



Mobile Service Caters to Valve Needs

Operating with a specially constructed truck this service man is lubricating plug valves. Mobile unit carries complete stock of valve lubricants, lubrication fittings, lubricant pumping equipment and spare parts. All makes of valves can be handled. Following two-year limited trial, service is now being expanded on a national scale, is available on company- or plant-wide basis.—Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa. 288E



PETROCHEMICALS...

To supply your needs—
PRESENT and FUTURE

At the Petro plant in Tuscola, Illinois an endless stream of natural gas is being separated into ethane, propane, butane, and natural gasoline. The ethane is converted to ethylene, which in turn is converted to ethyl chloride, ethyl alcohol, ether, and polyethylene. U.S.I. ammonia and sulfuric acid plants next door supply and receive raw materials.

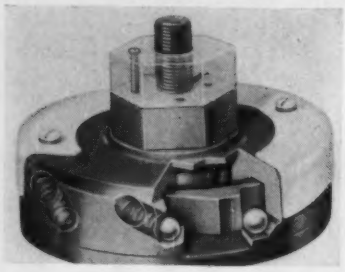
If you need one of these chemicals or one of the many others that Petro could manufacture, why not add this plant to your facilities. Our engineers will be glad to discuss your long-term bulk requirements for chemicals from Petro.

NATIONAL PETRO-CHEMICALS

CORPORATION

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

99 PARK AVENUE, NEW YORK 16, N. Y.



Backspin Ratchet

Prevents damage to vertical turbine pump on shutdown.

When a vertical turbine pump shuts down backspin from the receding liquid column can damage the pump and drive motor. To avoid this risk the new ACEC vertical hollow-shaft electric pump motor incorporates a ball-type, non-reverse ratchet to lock within 1/72 of a revolution.

Bal-lok's ratchet element is always stationary, while the ball retainer rotates with the motor. When the motor rotates in the proper counterclockwise direction centrifugal force lifts the balls clear of the ratchet so that they do not interfere with the rotation.

Once the motor stops the balls drop back into the ratchet recesses. Should the motor begin to turn in the reverse or clockwise direction, one or more balls will lock in the ratchet and prevent rotation.

Other features of the new motor: An overhung, canopy-type hood for complete protection against the elements; heavy-duty, single-row ball thrust bearings; grease or oil lubrication according to size; high capacity centrifugal-fan cooling; and dynamically-balanced rotors.—**ACEC Electric Corp., 40 East 49th St., New York 17, N. Y.** **290A**

Power Engine

For direct drive or power generation doubles former hp. coverage in single units.

According to the manufacturer the SW 14 engine is the first U. S. heavy-duty, relatively low-speed engine to operate continuously at brake mean effective pressures beyond 200 psi. This means the units will develop twice as much power as present same-size diesels.

These engines are built in 6 and 8 in-line, and 12 and 16 Vee designs with ratings from 1,360 to 5,000 hp. at 450 rpm. Basic design is four-cycle supercharged type with inherently low fuel consumption up to 10% overload.

Engines offer tri-power feature for operation either as oil diesels, dual-fuel diesels or spark ignition gas units. Any of these operates on the diesel compression cycle and is convertible to the other types without alteration of piston and cylinder heads.

The same major and miscellaneous small parts are fully interchangeable throughout the line in either vee or in-line construction. —**Worthington Corp., Harrison, N. J.** **290B**

Lighting System

Approved for areas where hydrogen or acetylene are present.

For chemical or refining processes using hydrogen or acetylene there is a newly available lighting system; the first complete system for Class I, Groups A and B.

Individual units in the system are similar in size and appearance to explosion-proof fittings and fixtures for Class I, Groups C and D. Thus installation and maintenance practices have been kept uniform.

System includes the following UL-approved components: 150 and 200-w. EVA 295 pendant lighting fixtures, EAB junction boxes, FSPC tumbler switches, EYS seals, UNY unions, and EC series flexible couplings and fixture hanger supports.

The new EVA 295 fixture has a one-piece housing, combining both body and hood to give extra strength. A different type of flametight joint is used at the critical union between the fixture's glass globe and metal retaining ring. Another flametight joint at the receptacle seals off the lamp and wiring compartments.—**Crouse-Hinds Co., Wolf and Seventh North St., Syracuse, N. Y.** **290C**

Silver-Plated Fuses

Overcome fuse heating problems, even when oxidized.

Taking a cue from a construction feature of high-quality switch gear the Shawmut line of fuses now has all contacts silver plated. Formation of non-conducting copper oxide is thereby prevented, eliminating heating problems commonly encountered.

Corrosive fumes and high temperatures may also oxidize silver, but silver oxide, unlike copper oxide, is a good conductor. Thus, if silver-plated fuses are used with unplated holders copper oxidation is reduced 90%; when both fuse and fuse holders are silver-plated, 100% protection is claimed.

Installed in panel boards, switches, motor starters, busways and other apparatus, S-P fuses reduce power loss and maintenance. —**The Chase-Shawmut Co., Newburyport, Mass.** **290D**

Lubricated Seals

Reduce friction under dynamic conditions.

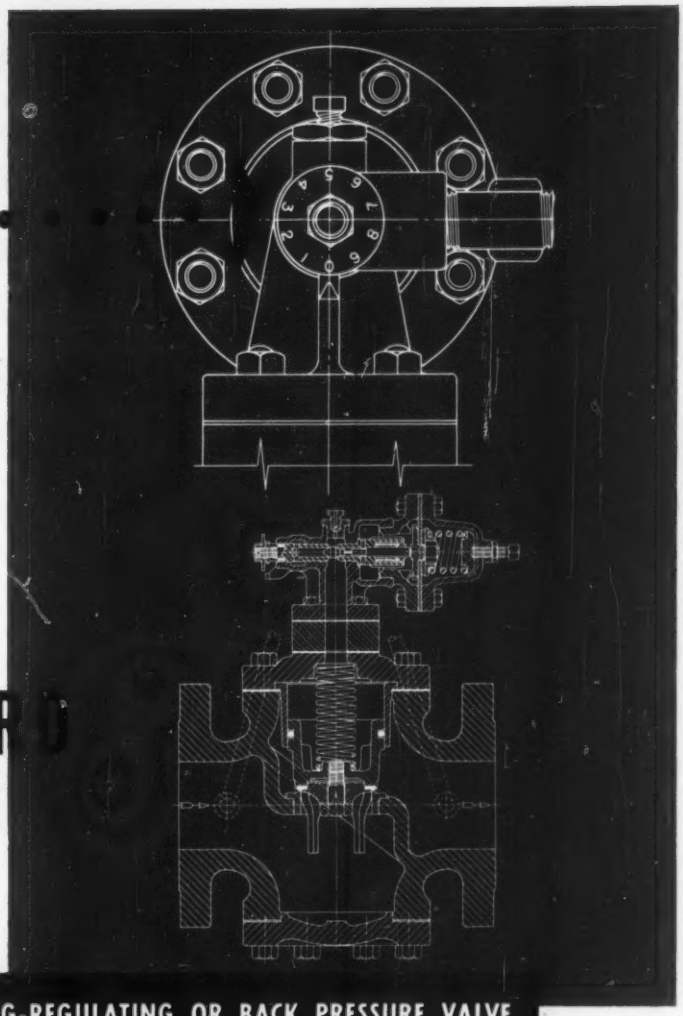
Working surfaces of rubber packing, O-rings, valve seats, resilient mountings and similar parts are lubricated by the Gorlube process to give low friction and long life. Friction is said to be less than with oil alone, and in combination with oil 40% less than oil alone.

Process incorporates laminar, solid lubricant molybdenum disulfide into the rubber. Type of part and end use determine whether lubricant will be dispersed uniformly throughout the material; concentrated in a thick impregnated outer layer; or as an impacted skin.

The impacted-skin type of Gorlube treatment may be applied to the outer surfaces of almost any molded rubber part after it is molded. The other types of treatment require special techniques in compounding, raw material preparation and molding.—**Goshen Rubber Co., Inc., P. O. Box 517, Goshen, Ind.** **290E**

FOR EXCEPTIONAL CONTROL

a pilot-operated valve with adjustable throttling range



the NEW Improved

CASH STANDARD

TYPE 10 VALVE

- SELF-CONTAINED
- SINGLE SEAT—tight closure
- LARGE CAPACITY

SERVES AS PRESSURE REDUCING-REGULATING OR BACK PRESSURE VALVE

- Improved Y-type strainer in pilot control line protects pilot.
- Simple dial-type range selector permits selection of throttling range required for the most stable and sensitive control.
- Switching control piping easily converts valve from pressure reducing to back pressure operation.
- Diaphragm assembly easily changed to convert to different pressure range.
- Packless design results in low friction and high sensitivity.
- Recommended for: water systems, altitude control, as an unloading valve on extrusion presses, back pressure control, oil refineries.
- For use with water, gas, air, light oils, refrigerants (ammonia, freon).
- Materials: iron, bronze or steel body; bronze or stainless steel trim; monel trim on pilot valve. Composition or metal seat.
- Sizes: 2" to 3" with screwed ends.
  2" to 12" with flanged ends.

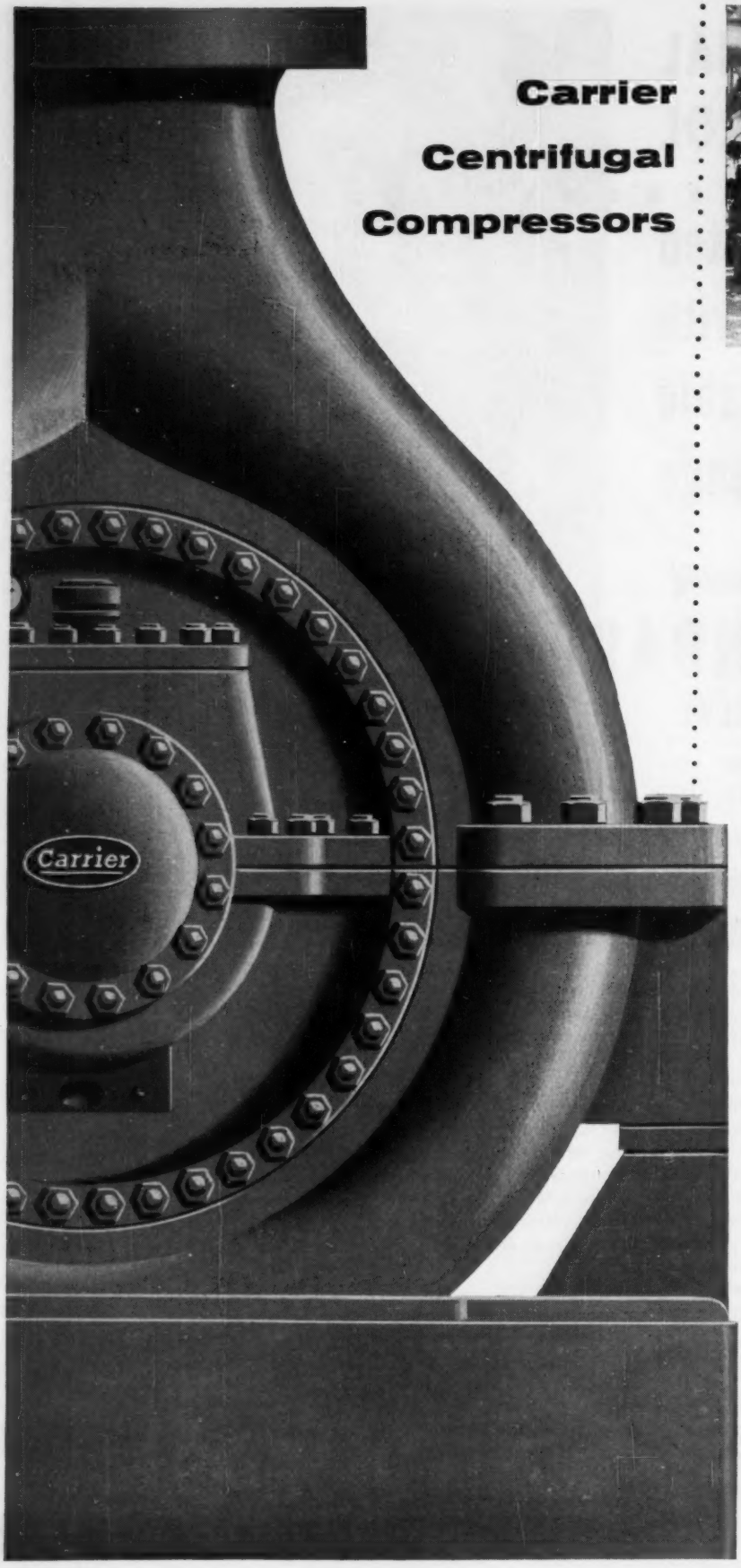


WRITE TODAY FOR COMPLETE INFORMATION AND LITERATURE

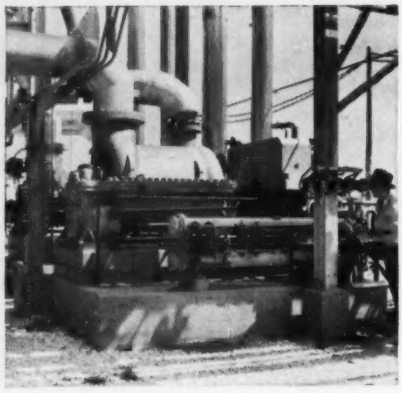
CASH STANDARD

A. W. CASH COMPANY • P.O. BOX 551, DECATUR, ILL.

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS



Carrier
Centrifugal
Compressors



on the job at
Lion Oil Company

Two Carrier Centrifugal Compressors are dependable links in the chain of operations at Lion Oil Company's Barton Ammonia Plant, Luling, La. Each compresses 8500 cubic feet of air per minute for burning with combustible gases in the secondary reformer furnace. Ammonia for synthetic fertilizer is the end product.

Carrier makes a complete line of centrifugal and axial flow compressors for gas compression and refrigeration—up to 10,000 hp in a single unit. Hundreds of these dependable, efficient Carrier machines are on the job at dozens of chemical plants and refineries across the country—Olin Mathieson Chemical Corporation, The Atlantic Refining Company, Wyandotte Chemicals Corporation, The Texas Company. May we assist you?

If you'd like a copy of our booklet, **"Centrifugal Compressors for Industry,"** please call your nearest Carrier office. Or write direct to Carrier Corporation, Syracuse, New York.

Carrier

centrifugal compressors
refrigerating equipment



PRESSURE, TEMPERATURE AND LIQUID LEVEL CONTROLLERS

Leslie Controllers consist of a single or double seated diaphragm control valve operated by a Control Pilot. The latter is an air, water or oil actuated device that produces a variable loading pressure to the valve diaphragm in response to a pressure, temperature or level change in the controlled medium. Controllers are used for any one or any combination of the following conditions:

★ When an exactly controlled level, pressure or temperature is required.

★ When power is needed to assure automatic valve opening after prolonged, tight shut-off.

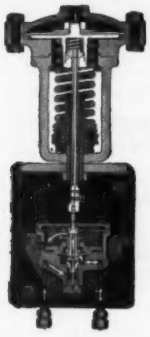
★ When power is needed to operate single-seated valves under high pressure drop.

★ When the available fluid pressure differential doesn't supply enough power for self-operation.

★ When extreme pressure reductions are necessary (i.e. 600 reduced to 10 psi, 900 to 2 psi, 2150 to 5 psi); all can be handled in one step.

★ When fluid contamination requires the simplest type regulating valve for dependable operation.

★ When operation from either a nearby or remote control station is desired.

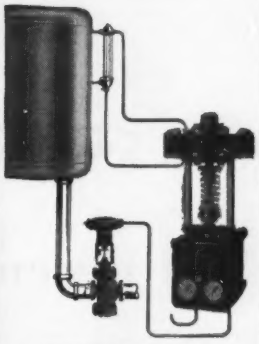


Control Pilot
Type PD

LESLIE
CONTROL PILOTS

Simple mechanical device employing constant supply of clean air, gas, water or light oil at 20-22 psi to produce a variable output or loading pressure of 0-20 psi in response to a level, pressure or temperature change applied to operate a control valve or power cylinder controlling fluid flow.

SEND FOR BULLETIN 5303



Floatless Level Control
Type UA-1

LESLIE
FLOATLESS LEVEL CONTROL

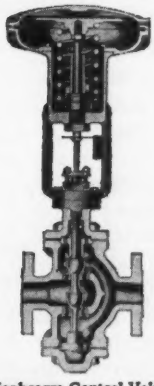
Provides accurate control of liquid level (plus or minus 1" water column). Eliminates problems caused by troublesome linkages, torque tubes, floats and stuffing boxes. Simple design provides steady, positive, precise control even under difficult conditions. Consists of Level Control Pilot and diaphragm control valve.

SEND FOR BULLETINS
5303, 5304, 5305

LESLIE
DIAPHRAGM CONTROL VALVES
(Double Seated)

Flow-line contoured body for high capacity, low pressure drop. Standard ISA face to face dimension in cast iron, cast bronze and cast alloy steels. Renewable, self-aligning guides. ½-10". To primary service rating of 600 psi—950° F. flanged, ring joint and welding ends.

SEND FOR BULLETIN 5305

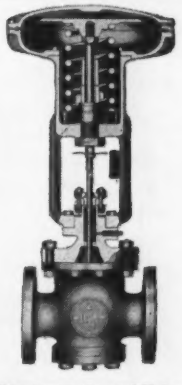


Diaphragm Control Valve
Double Seated Class DV

LESLIE
DIAPHRAGM CONTROL VALVES
(Single Seated)

Control flow of steam, liquid, air or gas. Tight shut-off. Operated automatically by air, water or oil pressure supplied from a Control Pilot or from a loading device such as LESLIE Air Loading panel. Available in unbalanced or fully balanced types, ½-10" in cast bronze, cast iron and cast alloy steels. Primary service ratings to 2500 psi, 1000° F.

SEND FOR BULLETIN 5304



Diaphragm Control Valve
Single Seated Class DL-1

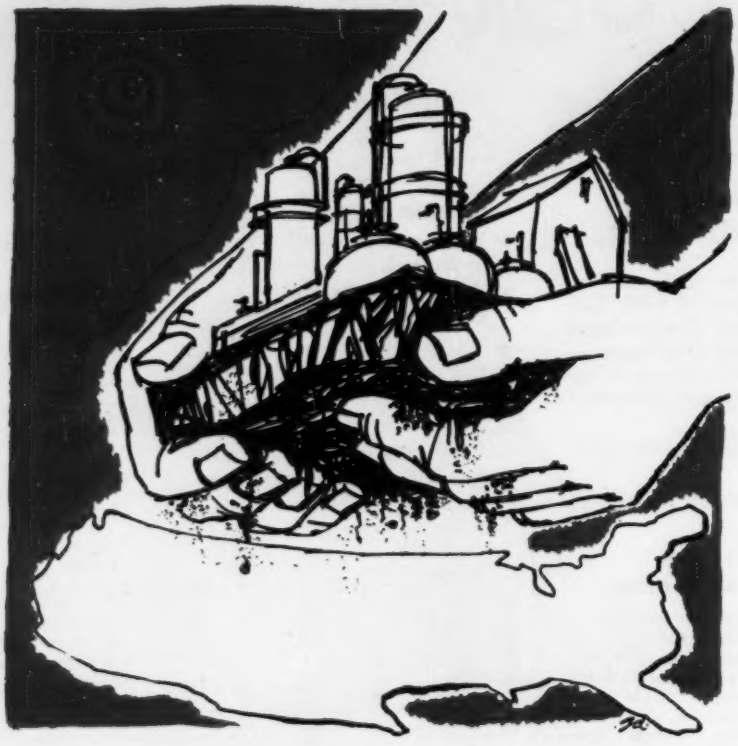
3189

LESLIE CONTROLLERS

SINCE 1900

"STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

LESLIE CO., 279 GRANT AVENUE • LYNDHURST, NEW JERSEY



Chemicals Will Decentralize

Ever-growing emphasis on high-volume, low-cost chemical products is resulting in more and more geographical dispersion of plants in our industry.

Henry Wessel

If chemical expansion continues with its present speed and direction for the next 15-25 years, as it almost certainly will, major industry emphasis will be on high-volume, low-cost materials. The industry-wide transformation from fine specialties to bulk commodities production, started during World War II, will become increasingly apparent.

As never before, transportation costs—for bringing volume raw materials to processing plants, volume finished products to end users—will dictate plant location.

One easily seen result is greater and greater decentralization of the industry. But this pattern will depend not only on the amount of actual growth but on whether the pull to resources or to markets is stronger and to what extent these pulls work in unison or in opposition. So predictions of the geographical map of the chemical process industries 20 years from now can best be approached via a brief analysis of the dominant industry forces in both resources and markets.

HENRY WESSEL, *when he developed this article, was Head of Market Research at Midwest Research Institute, Kansas City, Mo. Last month, however, he joined International Minerals as Assistant to the Vice President for Engineering.*

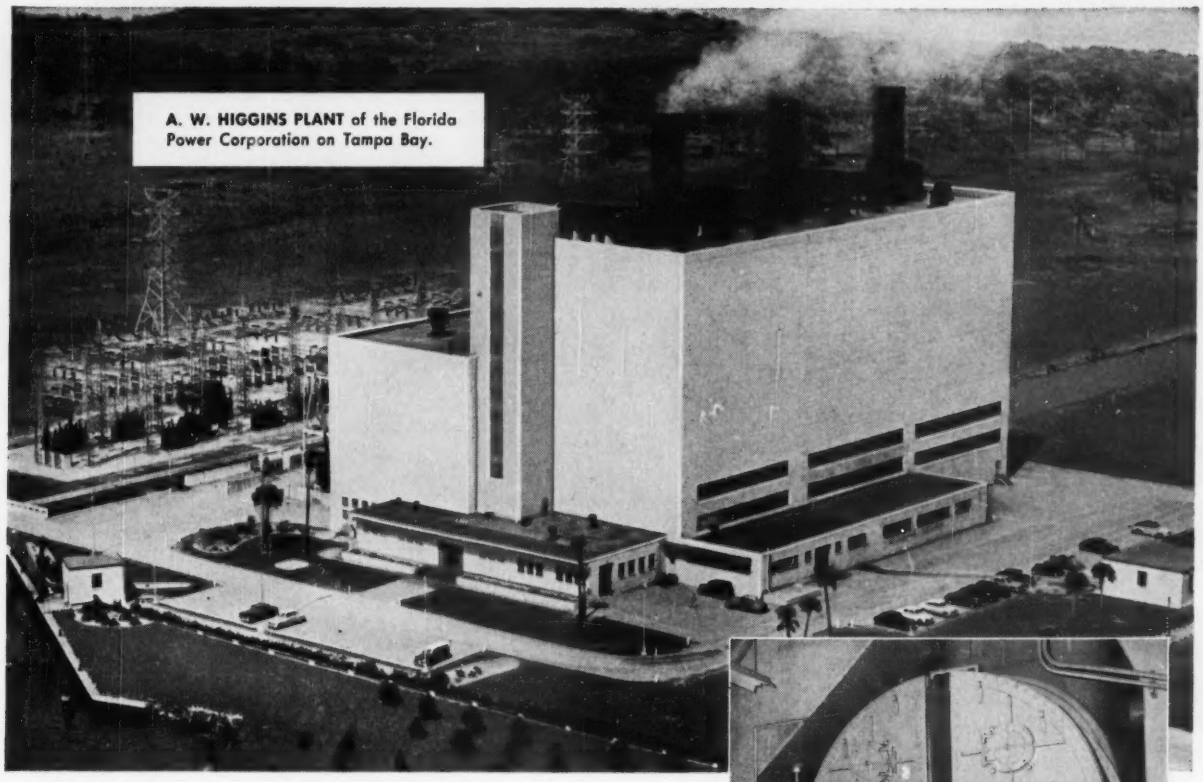
▶ **Supply Magnets**—The resources picture has been marked by increasing use of petroleum and natural gas as raw materials. True, there's also been a substantial boost in electrochemical output, such that power could be considered another important raw material, but petrochemistry has accounted for at least half the total rise in chemical tonnage in the last five years. And this trend should continue for at least the next decade.

▶ **Oil and Gas Dictate**—The move toward using petroleum and natural gas for the major part of chemical expansion has resulted in an increase in chemical construction along the Gulf Coast where supplies of these materials are abundant. About half the new plant investment in the U. S. since 1950 has been made in this area.

Whereas some 30% and 25% of the chemical industry was located in the Middle Atlantic states and the East North Central states, respectively, in 1950, only 12 and 16% of the Defense Production Authority chemical expansion was installed in these areas. On the other hand, the West South Central states, with 10½% of the chemical industry in 1950, accounted for 30% of DPA chemical expansion. The South Atlantic and East South Central states, which together had 20% of the chemical industry, just about held their own in expansion at 21%.

▶ **Oil Imports a Key**—The petroleum industry is expected to become an even more important supplier of basic chemical materials. One estimate puts total oil production used by the chemical industry at 2.7% by 1975—up from 0.7% today.

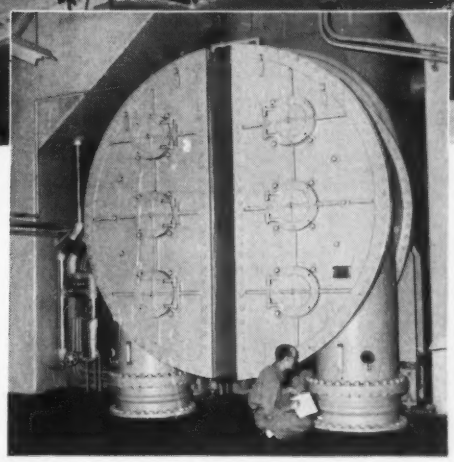
During this time both supply and demand of crude oil will probably double. However, crude oil imports are expected to hit 50% of the total and could have an effect on location of future petrochemi-



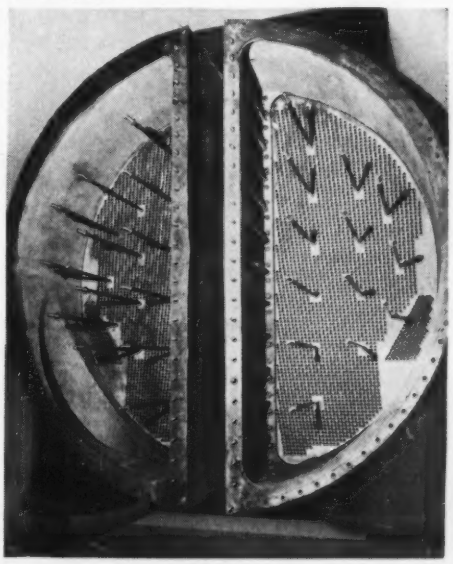
A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.

REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are $\frac{7}{8}$" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

cal plants on deep water–but not necessarily on the Gulf Coast.

▶ **Watch Coal**–Before World War II, aromatics made from benzene and coal tar were the most important. This branch of the industry has grown to the point where it exceeds production of byproduct benzene from the steel industry and now operates on benzene from petroleum as well.

However, indications are that some reversal of this trend will occur and that the next 15-25 years will see substantial amounts of aromatics made by coal hydrogenation. Since coal is much more widely distributed than oil in the U. S. this could–and probably will –cause some relocation of the chemical industry.

Also, long-term trends of natural gas prices are upward. Unless chemical processes using this raw material can substantially boost yields, there's a ceiling on the quantities of chemicals that can economically be made from natural gas. At least one chemical company–Du Pont at its Belle Works –has developed an improved process for making synthesis gas from coal, though the ammonia industry which this plant serves has become more and more dependent on natural gas.

▶ **Marketing Magnets**–Until World War II, much emphasis in chemicals was on fine and specialized products. In using these, the amount and cost in finished products tend to be insignificant.

For example, spending by farmers for pest control runs about 1% of the value of all farm sales. For such chemicals, economy of operations resulting from an integrated plant or from a use-patented product advantage causes plant location to be relatively independent of markets or raw materials since transportation costs for both are relatively low.

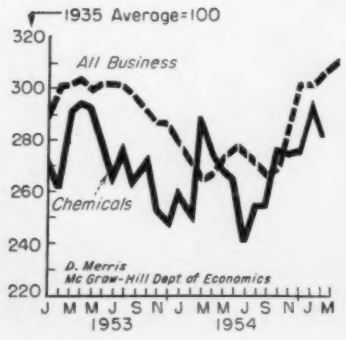
But as the trend grows toward volume production of basic chemical building blocks, plants' tonnage outputs will begin to equal or top tonnages of raw materials. If low-cost transportation of raw materials is available, this type of plant may tend to orient towards markets and the larger population centers of the country. The beginnings of this movement are apparent in the Tuscola, Ill., and Doe Run, Ky., petrochemical plants.

▶ **More Plastics, Fibers**–The two market areas earmarked by most chemical prophets for explosive expansion are plastics and synthetic fibers. Current plastics production is about 5% that of steel on a volume basis. But this is expected to hit 60% in the next 20 years. In synthetic fibers, production now is 20% of steel and is also expected

Are You Keeping Up With Our Industry Reviews?

Covered This Year:	Cement	June
	Chlorine—caustic	May
	Coke and coal chemicals	May
	Essential oils	Feb.
	Fertilizers	Jan.
	Metals	April
	Petroleum	April
	Resins and plastics	May
	Soaps and detergents	May
	Soda Ash	July
	Solvents	March
	Sulfur-sulphuric acid	April
	Textiles	March
Coming Next Month:	Chemicals in 1960! Market forecasts for six major groups—organics, inorganics ag chemicals, synthetic fibers, plastics and drugs. Also, an analysis of today's pulp and paper industry.	

Consumption Index



Business Activity (April).....311.5

Chemical Consumption March (Prelim.).319.7

Feb. (Rev.).....281.6

Indexes	March	Feb.			
Fertilizer	76.33	70.13	Paint & varnish...	31.85	25.02
Pulp & paper.....	36.37	32.02	Textiles	11.52	9.98
Petroleum refining.	29.73	27.49	Coal products....	10.66	10.71
Iron & steel.....	18.31	15.58	Leather	4.73	4.69
Rayon	33.15	27.10	Explosives	8.46	7.69
Glass	25.37	23.12	Rubber	7.72	6.73
			Plastics	25.53	21.36

Cut Costs

... increase profits with

POWERS

Automatic

TEMPERATURE

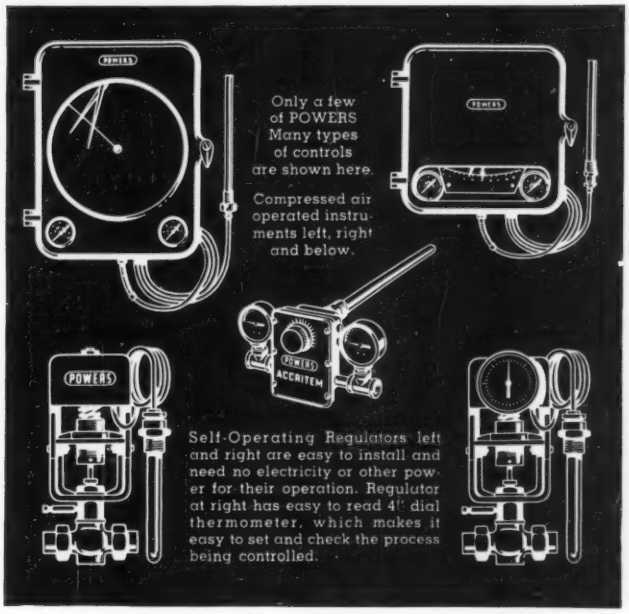
and Humidity Control



FLOWRITE
One of Powers Premium Quality Diaphragm Control Valves. They're simple, sturdy and dependable.

(c3)

VALVES: Available in a variety of body types and inner valves.



Improved Product Quality quickly pays back a big return on the investment in Powers Control

By eliminating the wastefulness of human errors with the dependable accuracy of Powers automatic control you eliminate losses caused by OVER-heating or Under-heating.

You will get better control if you use the right type temperature controller and proper size control valve for your requirements. An experienced Powers engineer will gladly help you.

Call Your Nearest Powers Office or Write us direct

THE POWERS REGULATOR CO.

Skokie, Ill. • Offices in Chief Cities in U.S.A.
Canada and Mexico • See your phone book

OVER 60 YEARS OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

to go to 60% in the next 20 years.

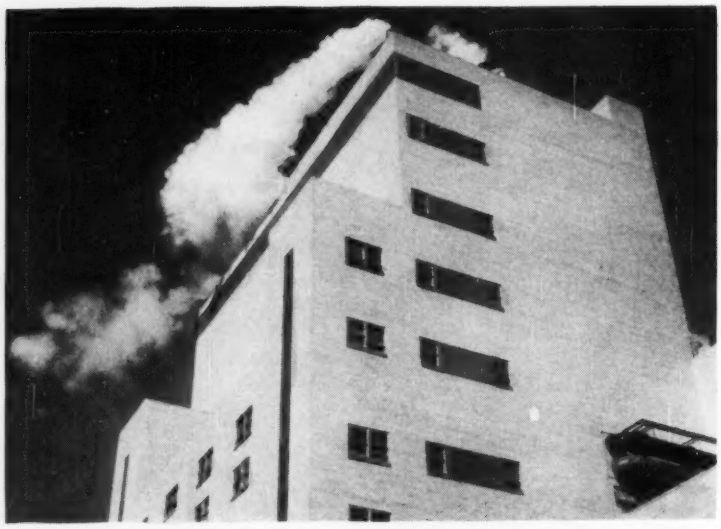
Generally the chemical industry is expected to quadruple by 1975 from the 1950 level. Now plastics account for 25-30% of the total sales of three of the six biggest U. S. chemical firms. And the plastics field will increase tenfold by 1975. Medicinal chemicals, on the other hand, typical of the chemical specialties that played such a big role in the industry in the last 20 years, are expected to increase only about 50% in that period.

▶ **Growth and Integration**—Compared with its projected size 15 years from now, the chemical industry was virtually nonexistent before World War II. Production indices show 1939 at 100, 1950 at 270, 1955 at 360, 1962 at 460. Some predictions put 1975 at over 1,000.

One recent development that provides for both the supply and marketing needs of this future colossus is vertical integration—from raw materials to chemical end products and even into the consumer goods market.

Because of the ramifications in chemical end-use, many major industry segments outside the chemical industry are becoming chemical makers themselves. Industry appears to be dividing into two main camps: process industries which modify raw materials (and chemical methods are becoming more important for these modifications), and fabrication or assembly industries which turn out final consumer products.

Many large petroleum companies now count chemicals among their major profit-makers. The rubber industry is becoming a major chemical producer, not only via synthetic rubber but through its participation in the plastics boom. Last year's merger of the Mathieson Chemical Co. and Olin Industries illustrates vividly the trend toward vertical integration from raw materials to markets. And this integration is a vital component of the long-term picture of a more geographically dispersed U. S. chemical industry.



NEW soda ash plant of Solvay at Syracuse has replaced 40-year-old facilities.

Soda Ash Target: 6 Million

Tied as it is to America's chemical economy—your business—soda ash may reach its predicted production rate of 6 million tons this year.

Robert C. Miller, Stanford Research Institute

Consumers of soda ash last year took better than 5.2 million tons of this basic product. Although it declined slightly from its previous 5.3 million, there are significant changes going on in its end-use pattern. These shifts and the strategic importance of soda ash will keep it on its traditional growth path of 4% per year. Production may even reach 6 million tons in 1955.

Major upward trends in the con-

BOB MILLER *is manager of Chemical Economics Research at SRI, Stanford, Calif. He was assisted by the staff of the* Chemical Economics Handbook *in preparing this article.*

Where Our Soda Ash Goes

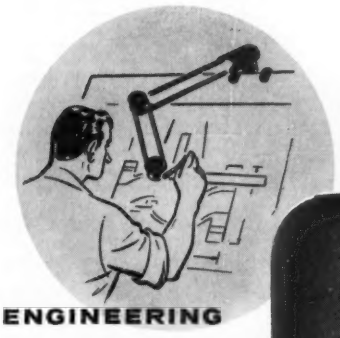
	1953	1954
	(Thousands of Tons)	
Glass	1,520	1,490
Caustic & bicarbonate	736	704
Non-ferrous metals	417	487
Pulp & paper	330	312
Soap	100	88
Cleansers*	158	154
Other chemicals	1,270	1,281
Water softeners	120	117
Textiles	40	31
Exports	165	164
Petroleum refining	33	33
Miscellaneous	414	352
	5,303	5,213

Chemical Engineering estimates. Based on 100% Na_2CO_3. *Includes modified sodas.

How Other Chemicals Consume Ash

	1953	1954
	(Thousands of Tons)	
Calcium carbonate	188	184
Sodium chromates	109	99
Sodium hydrosulfite	12	13
Sodium nitrate	168	164
Sodium phosphate, tripoly	350	388
Dibasic	8	9
Tetra	64	72
Other*	57	51
Sodium silicate	230	228
Sodium sulfite	44	43
Sodium thiosulfate	15	15
Unaccounted for	25	25
Total	1,270	1,281

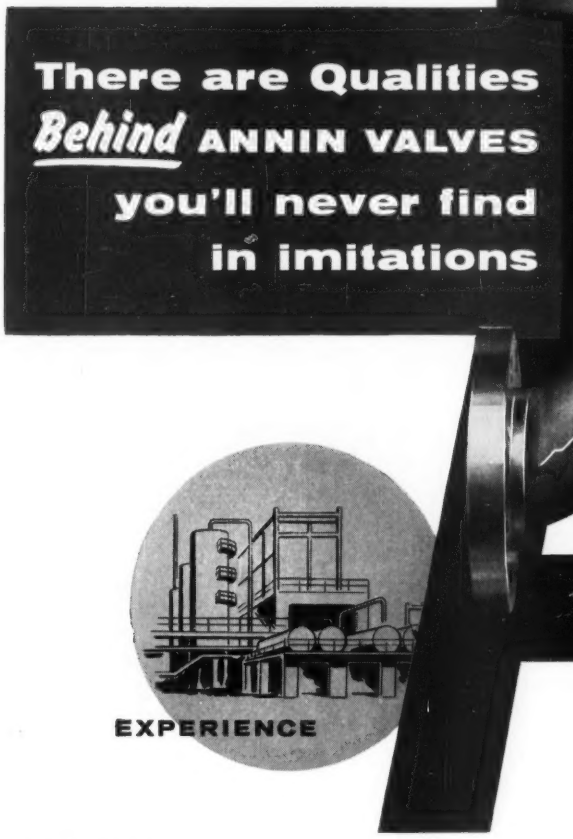
* Tribasic sodium phosphate consumes approximately 28%; monobasic, 6%; meta, 54%; acid pyro, 12%.



ENGINEERING



RESEARCH & DEVELOPMENT





QUALITY CONTROL

EXPERIENCE

There are Qualities *Behind* ANNIN VALVES you'll never find in imitations

ANNIN DEVELOPED AND INTRODUCED:

SPLIT BODY

The Annin split-body design has given Industry new standards in control valve construction: lower body pressure loss, greatly reduced erosion, greater rangeability, longer life and reduced maintenance.

DOMOTOR OPERATOR

Out-performs all other pneumatic valve actuators. They are the highest speed, most powerful, and provide the best response characteristics. Long strokes assure that all size valves are truly hi-lift control valves.

TEFLON SEAT SEAL

The teflon seat seal for absolute tight closure, teflon guide bushing to eliminate guide clearance, and teflon V-ring packing for reliable stuffing-box performance were developed and introduced by Annin.

DOOLSEAL

Providing a new high in stuffing-box practice, the Doolseal, originally developed and introduced by Annin, assures reliable seal for hard-to-handle or toxic chemicals without resorting to mechanical seals.

...and many others!

CUT INVENTORY **50%** WITH

ANNIN *Control* VALVES

THE ANNIN COMPANY
6570 East Telegraph Road
Los Angeles 22, California

sumption pattern of soda ash are evident in glass, pulp and paper, and nonferrous metals.

The glass industry, largest consumer of soda ash, has been forging ahead to catch up with demand since its general inventory liquidation in 1953-54. Booming automobile production combined with more glass per automobile has meant greater-than-expected requirements. This year's General Motors' automobiles have up to 33½ sq. ft. of glass compared with 29 sq. ft. two years ago and 22 sq. ft. in 1940.

The construction industry, too, is keeping glassmakers busy. More houses with more glass have stimulated demand for flat glass. Although production figures for flat glass are closely-kept secrets, plate glass in 1953 probably exceeded 425 million sq. ft., double the 1947 figure, while manufacture of ordinary window glass reached 1.3 billion sq. ft. compared with 947 million in 1947. Pittsburgh Plate Glass Co. has begun construction of a $34,000,000 plate glass plant near Cumberland, Md., expected to be completed in early 1957. This expansion is certain to mean a corresponding increase in soda ash requirements.

Growth in pulp and paper production will have its effect on soda ash too. Hardwood pulping is expanding and may be a more significant consumer of soda ash within 5 to 10 years.

The importance of soda ash to other segments of the chemical industry is shown in the table on page 298. Sodium tripolyphosphate, used largely in synthetic detergents, is the major consumer in this group.

The soda ash industry has been quite hard hit at several points in its history by strikes. In 1950, starting June 13 and lasting nearly four months, the output of six plants was affected by strikes. At the end, three quarters of the national capacity was involved. Starting at the three Solvay plants, Diamond Alkali and Wyandotte were struck later in quick succession. Sharp increases in demand brought about by the Korean War resulted in expansion of natural soda ash production in the West and attempts to increase imports. The loss of about 600,000 tons of production led some observers in that period to conclude that soda ash might remain in poor supply indefinitely; however, history has shown these fears to be unfounded.

A strike at Wyandotte starting Jan. 30, 1955, and ending April 22, indicates that the soda ash industry is again approaching its historically normal state of overcapacity: although the Wyandotte strike lasted 82 days, no significant shortages were reported by consumers, and other suppliers indicated they had no difficulty in supplying requirements while the strike was on. However, all producers except Wyandotte were reported to be operating at capacity. The stable price of soda ash during the strike also indicates that adequate supplies are available. Some displacements in the market occurred, however, during the recent strike by the L & N Railroad which serves several soda ash plants in the South.

Should expansion of soda ash capacity be required, industry management may face a difficult problem of economic justification for the expansion. According to John A. Sargent of Diamond Alkali, the investment in plant and equipment required for a 1,000 T/D soda ash plant in 1951 was $30,000,000 compared with $13,500,000 for a like plant in 1940. This increase of 122% in the investment required has not been reflected in higher prices of soda ash, so that the return on total operating investment (with depreciation computed on the basis of 1940 cost) would be only 1.1% versus 9.5% in 1940. However, except for Dow's Free-

Soda Ash: Who, Where, How & How Much

The first company to produce ammonia soda in the United States was organized in 1881. As the demand for soda ash grew, other companies entered the field so that today there are six companies operating 11 plants.

As the ammonia-soda process plants expanded, so, too did production of natural soda. Today there are six natural soda ash producers in the United States. Natural ash has been growing at a rate of about 7% per year, compared with 4% for the ammonia-soda process.

Company and Location	Process	Capacity[1]
Solvay Process Div.		
Baton Rouge, La.	Ammonia	750
Detroit, Mich.	Ammonia	930
Syracuse, N. Y.	Ammonia	950
Wyandotte Chemicals Corp.		
Wyandotte, Mich., S. Plant	Ammonia	182[4]
Wyandotte, Mich., N. Plant	Ammonia	511
Keeler, Calif.[2]	Natural	[5]
Diamond Alkali Co.		
Painesville, Ohio	Ammonia	727
Olin-Mathieson Chemical Corp.		
Lake Charles, La.	Ammonia	365
Saltville, Va.	Ammonia	274
Columbia-Southern Chemical Co.		
Barberton, Ohio	Ammonia	585
Corpus Christie, Tex.	Ammonia	240
Bartlett, Calif.	Natural	15
Dow Chemical Co.		
Freeport, Tex.	Caustic	110[6]
American Potash & Chemical Co.		
Trona, Calif.	Natural	145
Kaiser Aluminum & Chemical Co.		
Lone Pine, Calif.	Natural	35
West End Chemical Co.		
West End, Calif.	Natural	500
Intermountain Chemical Co.[3]		
Green River, Wyo.	Natural	300
Dry Lakes Chemical Corp.		
Cortago, Calif.	Natural	[7]
Total		6,619

[1] Thousands of short tons per year, estimated. [2] Natural Soda Prod. Div. [3] Owned by Food Machinery and Chemical Corp. and National Distillers Products Corp. Operated by Westvaco Chlor-Alkali Div., FMC. [4] Standby, not operating. [5] Discontinued 6/52. [6] Under construction. [7] Not operating.

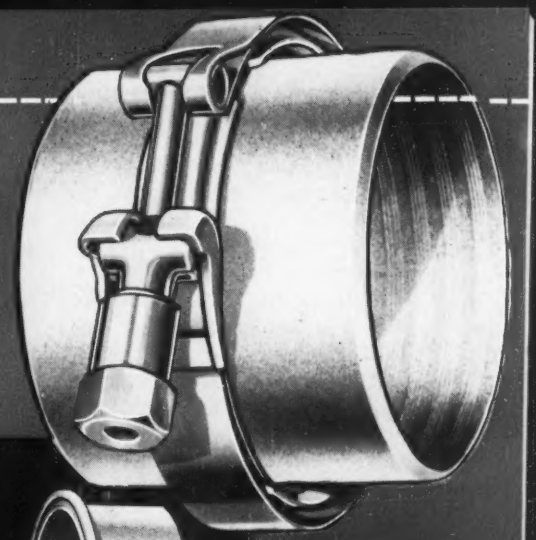
CUT PIPING COSTS

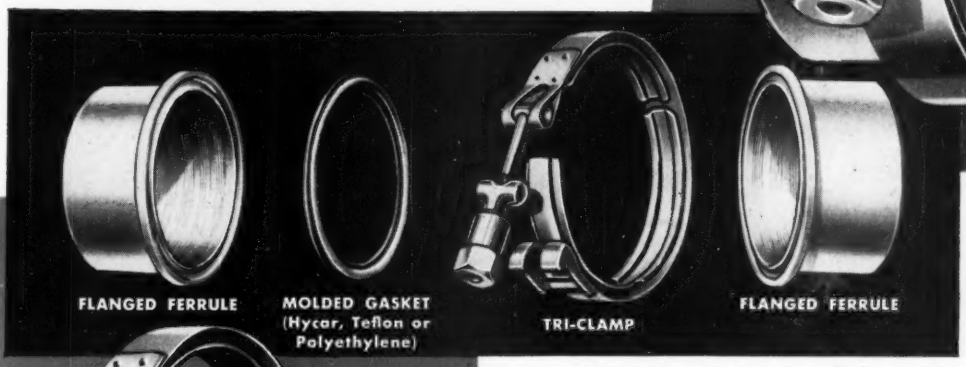
. . . with the NEW

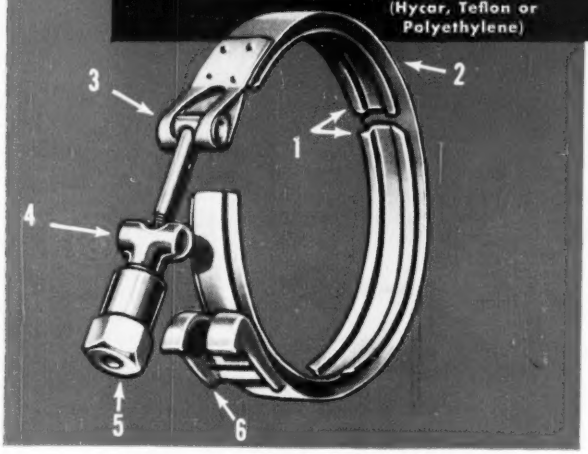
TRI-CLAMP

Schedule 5-10 and Tube O.D.

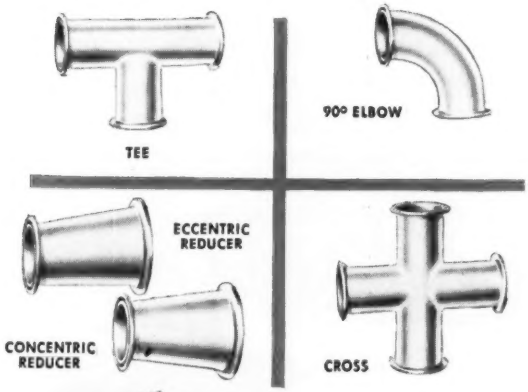
STAINLESS STEEL INDUSTRIAL FITTINGS







Tri-Clamp Industrial Type Stainless Steel Fittings are available in all standard types, in sizes from 1" through 12". Fittings are fabricated from type 304 and 316 stainless steel, and sizes through 4" are annealed, pickled and passivated.





. . . Send for NEW Bulletin . . .

Complete details on TRI-CLAMP Industrial Type Stainless Steel Fittings are covered in the new Bulletin 1055. Send for your copy now.

Simple Rugged Construction Assures Fast Positive Leak-Tight Joints

1. **RETAINER SECTIONS** grip flanged ferrules securely, assures proper alignment.

2. **TENSION BAND** equalizes pressure around joint, holds clamp in position for quick connection.

3. **TRUNNION** is of simple design, provides fast locking and unlocking action.

4. **"T" LATCH** assembly easily snaps into position in Coupler (6) and is held in position by tightening nut (5).

5. **TENSION NUT,** easily tightened with ordinary hex wrench.

6. **COUPLER SEAT,** holds Latch securely in place to complete positive, leak-tight joint.

As illustrated, the TRI-CLAMP Joint consists of a flange type ferrule—a special precision molded gasket which fits into the grooved ferrule lip—and the TRI-CLAMP itself, which is composed of a specially fabricated spring clamp which grips the ferrule edges, and a simple, bolt-type coupler assembly firmly secured to the clamp ring . . . always in position for instant assembly or disassembly.

All that is necessary for installation is to attach the ferrules to stainless steel tubing or pipe, insert gasket into position, slip TRI-CLAMP over ferrules and gasket and tighten into closed position—to produce a positive, leak-tight joint.

TRI-CLAMP Stainless Steel Fittings offer an entirely new concept of fitting design and fabrication, offering much greater speed and ease of installation, together with appreciable savings in original investment cost, and longer trouble-free life for many types of corrosion-resistant liquid conveying line service.

See your nearest Tri-Clover distributor, or write:

LADISH CO.
Tri-Clover Division
Kenosha Wisconsin

TRI-CLOVER

EXPORT DEPT., 8 So. Michigan Ave., Chicago 3, U.S.A.

1355

port, Tex., plant due to be on stream this year, no major expansion of soda ash is anticipated for the foreseeable future.

Soda ash has traditionally been offered in two grades: dense and light. Within the last year or two a medium grade, averaging 42 lb./cu.ft., has come into the market. This grade is now preferred by at least one major soap company, primarily because it is 5¢/100 lb. cheaper than the dense grade formerly used. The medium grade was first developed by the natural soda ash producers, but the synthetic producers are also now offering a similar grade.

The price of soda ash has varied from $1.05/100 lb. to $1.362/100 lb. since 1930. The current price schedule is $1.35/100 lb. for light and $1.40/100 lb. for dense ash in CL bags, fob. manufacturer's works. Special grades run as high as $1.50/100 lb.

The outlook for soda ash is stable. It appears likely that the production of soda ash will continue to increase at about the historical rate of 4% per year unless important new uses for the material are developed.

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

Ammonium Nitrate—Three Processes **320**

NAMES IN THE NEWS

Allan J. Greene, on the board of Chas. Pfizer & Co. **327**

Names that made news last month **328**

PRO AND CON

Applicants vs. Employers **336**

TECHNICAL BOOKSHELF

Newcomers for your reference shelves **340**

Recent books & pamphlets **344**

FIRMS IN THE NEWS

Who's doing what among your suppliers **346**

TECHNICAL LITERATURE

Manufacturers' new literature **422**

COMING SOON

When to replace your equipment or plant .. **Aug.**

How to use statistics in experiments ..... **Aug.**

Cost of installing centrifugal pumps ..... **Aug.**

Solids concentration methods: A report .... **Aug.**

How to analyze your maintenance costs ..... **Sept.**

Bio-oxidation of process wastes: A report ... **Sept.**

Drying: A report ..... **Oct.**

3 ways to ammonium nitrate.

There're three important commercial processes — Stengel, prilling and crystallization. Here's a picture of how they work in three new plants. (p.320)

Find it hard to keep up?

Maybe you should keep closer tabs on new reference books coming out. Technical Bookshelf is your monthly guide. (p. 340)

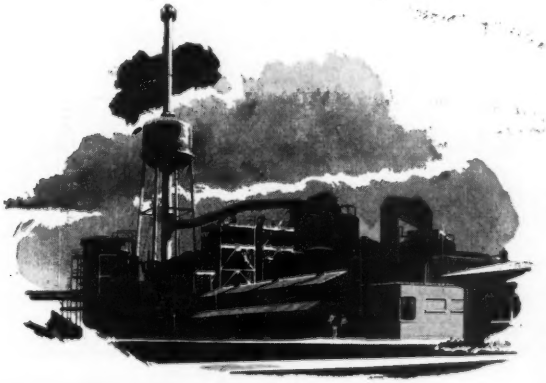
New technical literature!

You can now get—free and fast—literature on any subject in your field. Keep your files up to date the easy way. (p. 422)

Join READER SERVICE
Inside Back Cover



Hold on there!... there's a better way!



YOU CAN NOW DISPOSE OF YOUR SLUDGE SULPHURIC ACID BY SHIPPING IT BACK TO CONSOLIDATED FOR REGENERATION

Two unique sludge acid regeneration units at Houston and Baytown, Texas, were recently put on stream by Consolidated's Southern Division.

The new facilities will convert into new white sulphuric acid any grade of sludge—providing only that it can be pumped from the tank car or barge.

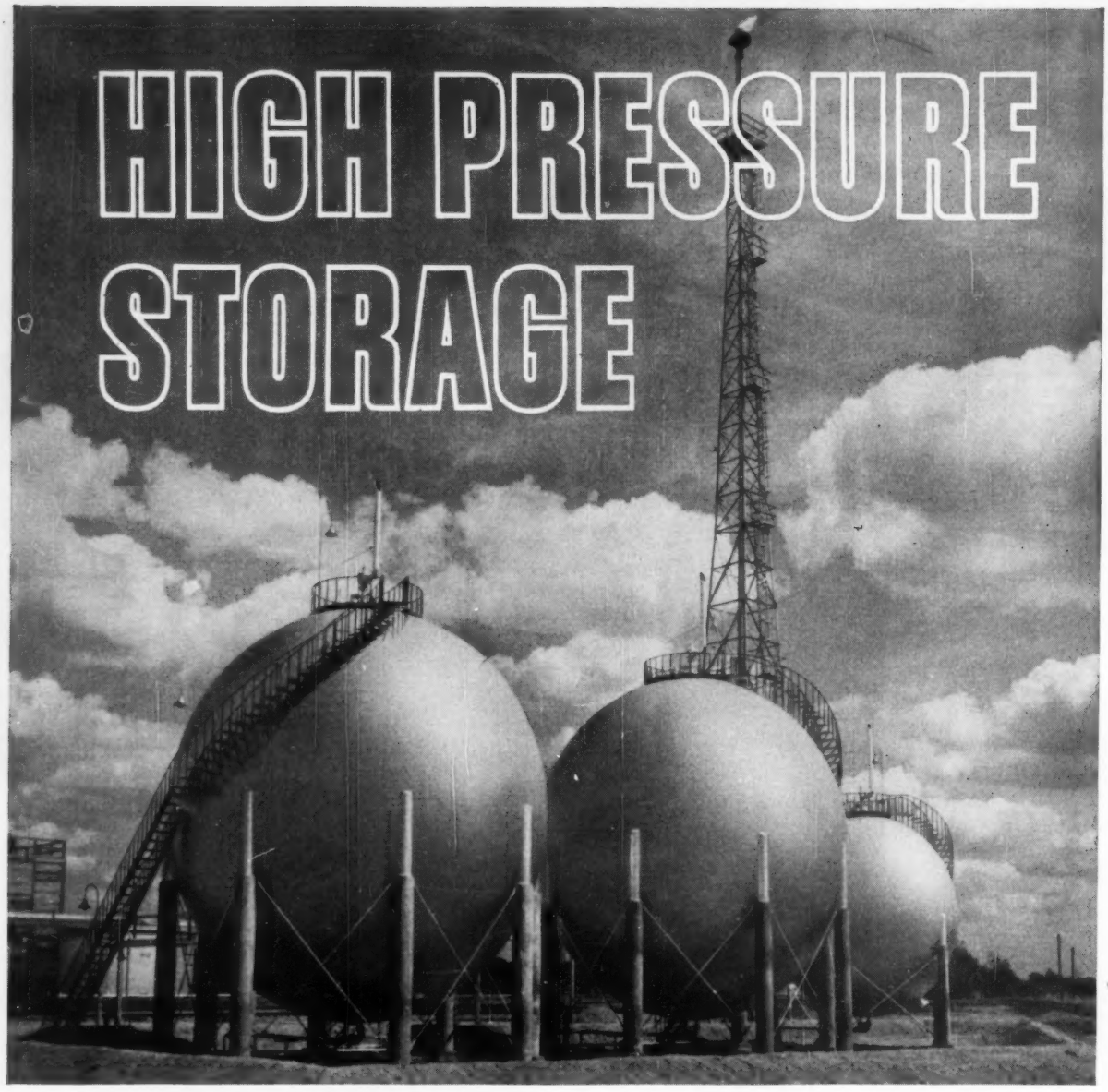
This new Consolidated service relieves petrochemical plant managers of the expense and bother of disposing of sludge by other means. Furthermore, it completely eliminates the danger of air and stream pollution.

Talk to the Consolidated man about your sludge acid problems. He can help you.



CONSOLIDATED CHEMICAL INDUSTRIES INC.

640 ESPERSON BUILDING • HOUSTON 2, TEXAS 380 MADISON AVE. • NEW YORK 17, NEW YORK



GRAVERSPHERES

solve gas and liquid storage problems

For pressure storage of process butane, iso-butane, natural gasoline and other volatile liquids and gases, Graverspheres are a "natural."

Graverspheres are formed in Graver shops and are first carefully assembled to insure accurate fit. After this they are shipped to location, erected and field-welded.

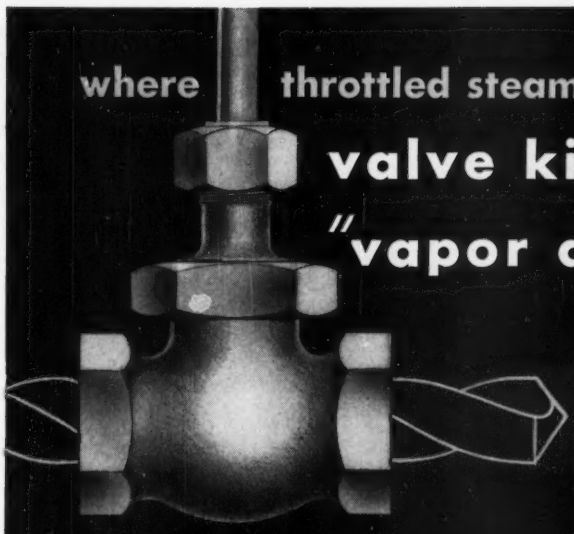
These spheres—the very shape of which is ideal for high-pressure storage in quantity—are available in capacities from 1,000 to 30,000 bbl. For gas storage Graverspheres are made to withstand pressures up to 100 p.s.i.g. and for liquid storage from 20 to 90 lb. water pressure.

As is the case with Graver tanks, towers and pressure vessels, traditional Graver quality and craftsmanship are inherent in Graverspheres.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL.
CATASAUQUA, PA. • PITTSBURGH • CLEVELAND • DETROIT • TULSA
SAND SPRINGS, OKLA. • HOUSTON • ODESSA, TEXAS • CASPER, WYO.
LOS ANGELES • FONTANA, CAL. • SAN FRANCISCO

GRAVER builds tanks, towers and pressure vessels for the chemical and petroleum industries

where throttled steam is a valve killing "vapor drill"



JENKINS PLUG TYPE VALVES

with the

500 BRINELL

STAINLESS STEEL ARMOR SEAT

will lower costs

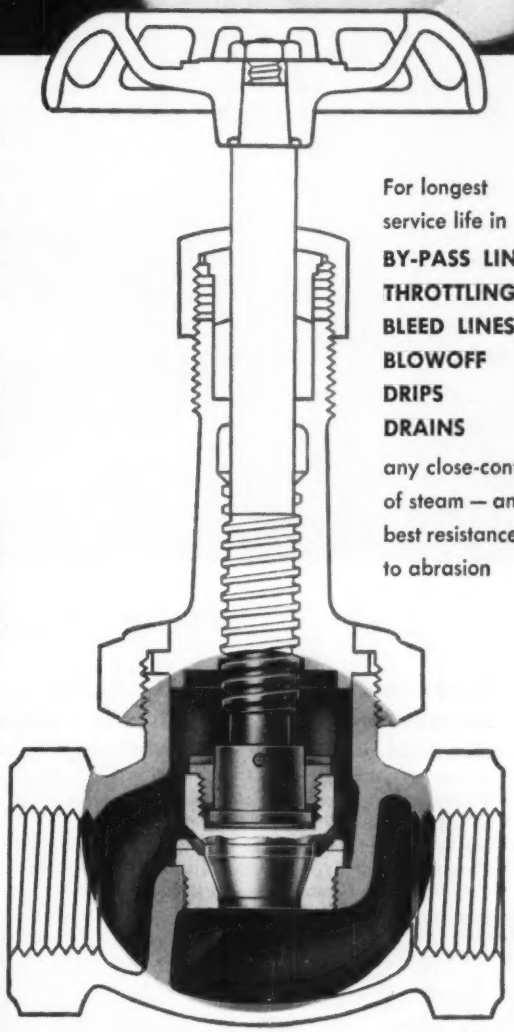
Closely regulated steam erodes grooves in seating units and drastically cuts service life of ordinary valves.

Jenkins Plug Type Valves have been engineered in every detail for maximum wear in such valve-killing service. The stainless steel Armor Seat defies the "vapor drill", and Jenkins quality throughout gives them top rating for wear-proof and trouble-proof perfomance.

Make you own test . . . in your toughest steam service . . . or anywhere that abrasion or erosion causes frequent valve failure. Compare, part for part, with any similar valve. You'll find that, again, Jenkins *extra value* pays off in longer life and lower maintenance cost.

Plug and seat ring are Jenkins JX500, a Stainless chromium alloy steel made to Jenkins high strength specifications, heat-treated to 500 Brinell. Seating surfaces are super-hard and mirror-smooth, offer highest resistance to galling, cutting, abrasion, and erosion. Wide, steep, 30° total taper permits extremely close regulation of flow and vapor-tight closure.

The Stainless steel plug is securely fastened to the spindle with a bronze locknut. Spindle is aluminum bronze with a tensile strength exceeding 70,000 lbs., — has high corrosion resistance.



For longest service life in

BY-PASS LINES
THROTTLING
BLEED LINES
BLOWOFF
DRIPS
DRAINS

any close-control of steam — and for best resistance to abrasion

300 lb. 200 lb. 150 lb.
GLOBE and ANGLE

For complete information call your Jenkins Distributor — ask for Form 202. Or write: Jenkins Bros., 100 Park Ave., New York 17.

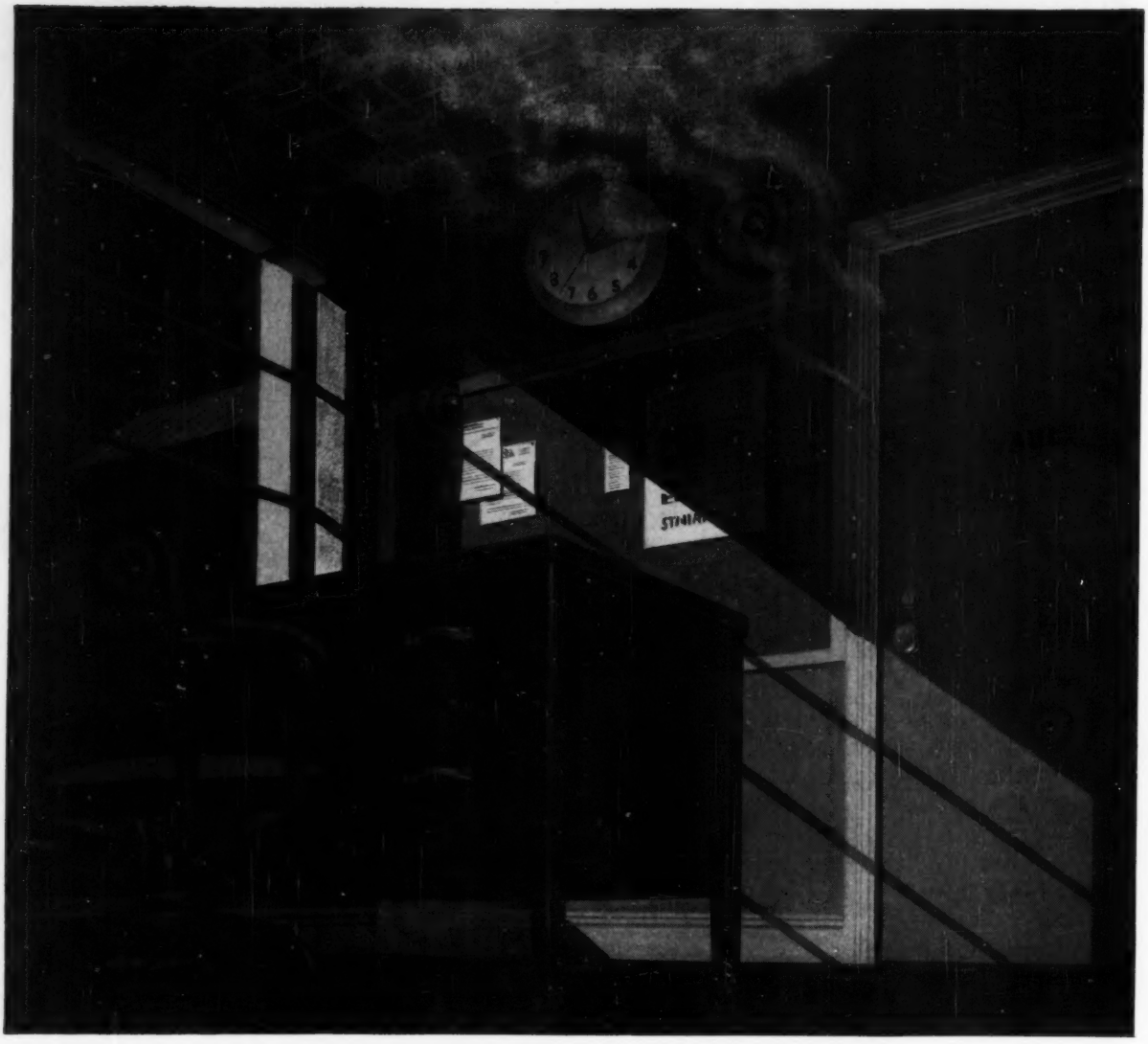
SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros



WHAT HAPPENS NEXT?

If management has been wise, a fire tragedy will be stopped before it starts...if not, in 20 minutes extensive destruction and total loss could readily be the result.

First-rate fire protection is essential to the continued success of any business. With C-O-TWO Smoke or Heat Fire Detecting Systems, plus C-O-TWO High Pressure or Low Pressure Carbon Dioxide Type Fire Extinguishing Systems, as well as PYRENE Air Foam Type Fire Extinguishing Systems for specific outdoor locations, your plant can have fast, positive round-the-clock fire watchman service simultaneously at each fire hazard point . . . a fire tragedy is stopped before it starts.

Furthermore, there is a personal sense of responsibility inherent with PYRENE—C-O-TWO Fire Protection Engineers that assures you of fully adequate firesafety . . . a definite plus in your behalf. Whether it's fire detecting or fire extinguishing . . . portables or built-in systems . . . PYRENE—C-O-TWO means top quality backed by experienced engineering that results in operating superiority for you at all times.

Act now . . . don't take unnecessary chances with your investment any longer . . . the extensive experience of PYRENE—C-O-TWO over the years is at your disposal without obligation. Remember . . . a plant-wide fire protection survey skillfully executed today could be the means for greater profits tomorrow.

PYRENE — C-O-TWO

NEWARK 1 • NEW JERSEY

Sales and Service in the Principal Cities of United States and Canada

COMPLETE FIRE PROTECTION

portable fire extinguishers . . . built-in fire detecting and fire extinguishing systems

CARBON DIOXIDE • DRY CHEMICAL • VAPORIZING LIQUID • SODA-ACID • WATER • CHEMICAL FOAM • AIR FOAM

Lapp Valves are Solid Porcelain

You need to make no compromise with contamination or corrosion from valves in chemical processing. Lapp valves are of *solid* Lapp Porcelain, a material unique as a ceramic for industrial scale chemical service. It alone offers the following combination of characteristics and qualities:

PURITY • Lapp Porcelain is a potassium aluminum silicate, made from selected clays, flint and feldspar...has no free iron or other metallic impurity.

NON-POROUS • Complete vitrification of all sections, through firing to 2300°F., provides *zero* porosity. No dye penetration of body in 100,000 psi test. No chemical can penetrate in service.

HIGH MECHANICAL STRENGTH

Compression strength ..... 100,000 lbs. per sq. in.
Tensile strength ..... 8,000 lbs. per sq. in.
Modulus of rupture ..... 15,000 lbs. per sq. in.

CHEMICAL RESISTANCE • Lapp Porcelain is unaffected by any acids except HF. It provides years of trouble-free service, handling hot acids in all concentrations, as well as mixed acids and other troublesome combinations.

UNIFORM QUALITY • Lapp Porcelain has been manufactured for 38 years for use in most severe chemical, electrical and mechanical services. Plant facilities include Lapp-patented vacuum processing, deaerating pug mills, two continuous tunnel kilns, and complete chemical, electrical and mechanical test equipment.

Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 416 Wendell St., LeRoy, N. Y.



An electrical test is the most searching inspection for physical soundness! Porcelain bodies for Lapp valves above are being flashed over—at 70,000 volts for three minutes. Any physical defect is revealed as an electrical puncture.

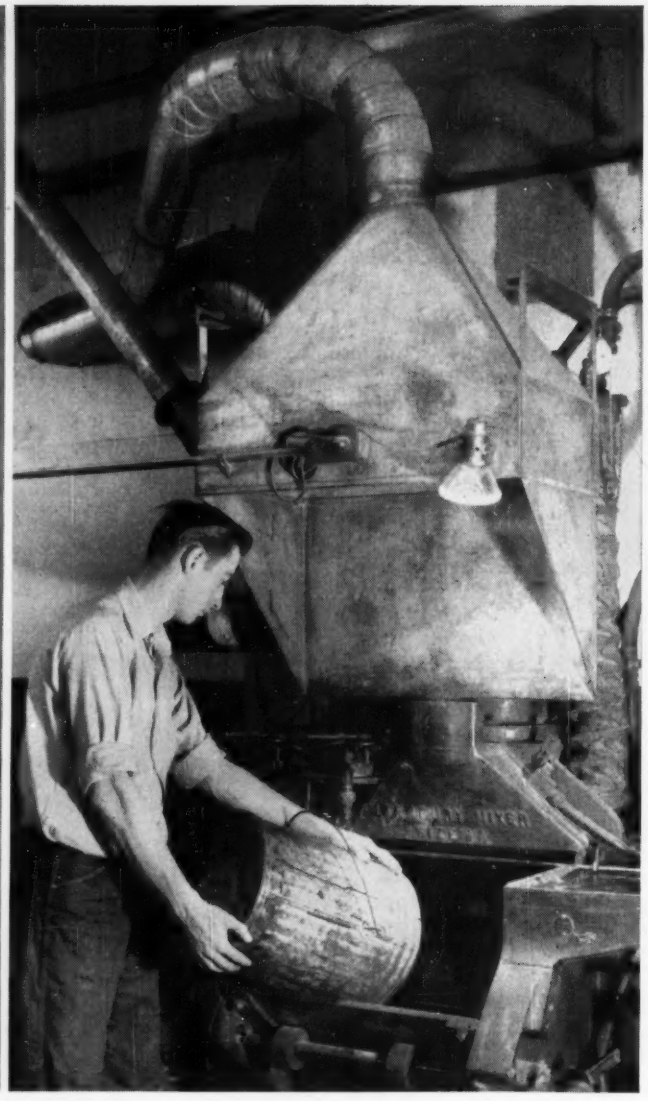
Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment.

Lapp

PROCESS EQUIPMENT

Chemical Porcelain Valves • Pipe • Raschig Rings
Pulsafeeder Chemical Proportioning Pumps

TURNING DUST from a PROBLEM to a PROFIT



Wheelabrator® DUSTUBES® *save $10,000 yearly for Lord Mfg. Co. ventilating Banbury Mixers*

Lord Mfg. Co. of Erie, Pa., operates two Banbury mixers to mix carbon black, sulphur and other materials with rubber stocks.

Hoods over the hopper, oven hopper, exhaust bearings and exhaust discharge gate of each Banbury keep carbon black and other material from escaping into the air.

Because this material is collected in the dry state by the cloth filter tubes in two Wheelabrator Dustube Collectors it can be returned to the batch. Savings of $10 to $15 per mixer per 8 hour day are achieved.

Besides the savings, however, the return of the material insures proper mixture throughout the batch cycle and maintains the quality of the batch.

In addition, the Dustube Collectors simplify housekeeping and establish better working conditions in the department.

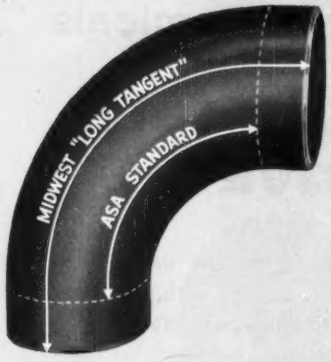
Investigate the many benefits of Wheelabrator Dustube Collectors. Send today for Bulletin 372.

American WHEELABRATOR® *high-efficiency cloth-tube dust collectors*

AMERICAN WHEELABRATOR & EQUIPMENT CORP. 347 Byrkit St., Mishawaka, Indiana



THESE MIDWEST "LONG TANGENT" ELBOWS SAVED $4121 IN PIPE



MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS

Here are 1227 Midwest "Long Tangent" Elbows (12″, 14″ and 16″ standard weight) ready for shipment to a chemical plant. Each Midwest "Long Tangent" Elbow has a straight section on each end equal in length to ¼ the nominal pipe size. Thus a 12″ elbow saves 6″ of 12″ pipe while a 16″ elbow saves 8″ of 16″ pipe. It doesn't take long to save a lot of pipe and a lot of money . . . in this instance $4121.

But saving pipe is not the only advantage of Midwest "Long Tangent" Elbows. They often eliminate short nipples and their extra welds . . . save time and money in lining up and clamping pipe and fittings . . . slip-on flanges are more easily applied. For all the facts, write for Catalog 54.

MIDWEST PIPING COMPANY, INC.
Main Office: 1450 South Second Street, St. Louis 4, Mo.
Plants: St. Louis, Passaic, Los Angeles and Boston

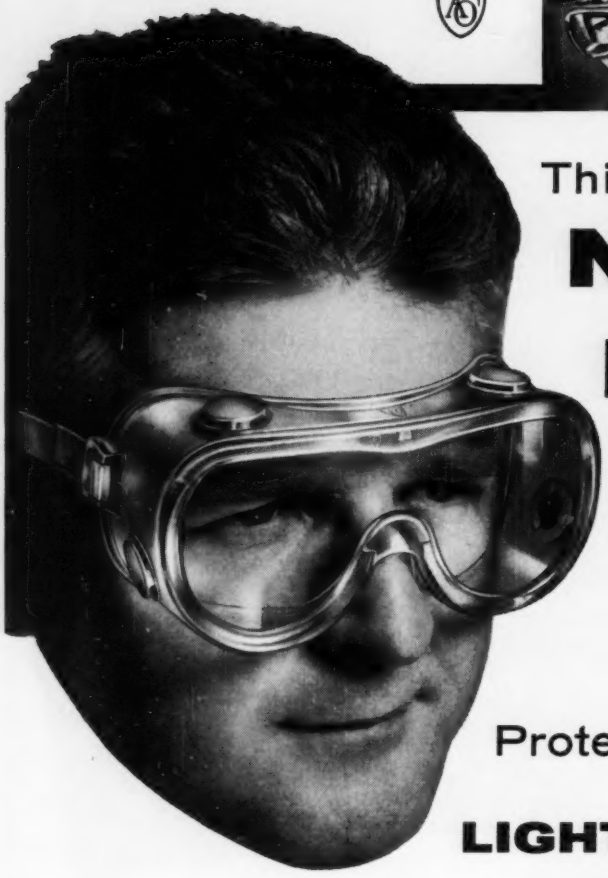
Sales Offices
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Boston 27—426 First St. • Los Angeles 33—520 Anderson St.
Houston 2—1213 Capitol Ave. • Tulsa 3—224 Wright Bldg.
Cleveland 14—616 St. Clair Ave.
STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

MIDWEST WELDING FITTINGS

MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs



7055





Eye Protection

This

NEW FLEXIBLE MASK GOGGLE

Offers Excellent Protection Against Chemicals

LIGHT...COMFORTABLE INEXPENSIVE

AO's new 484 and 485 Flexible Mask Chemical Goggles are now being supplied with four indirect ventilation ports or grommets which reduce fogging and insure maximum protection against hazardous chemical splashes. These moderately-priced AO goggles are light in weight — fit the face snugly and comfortably with a cushion-like effect. Extra wide and with ample clearance, they can be worn over most types of personal glasses or Safety Rx glasses. The interchangeable one-piece lens is *optically correct**, and offers superior resistance against acids and alkalis.

While made of a soft plastic material for flexibility, frame is solid and fits facial contours closely. There is an unusually wide field of vision for worker comfort, safety and efficiency.

Lens is easily removed and replaced and is available either clear or in green acetate. Plastic headbands are easily adjustable.

If impact goggles are desired, the No. 482 and 483 goggles with perforated frames, acetate lenses and elastic headbands are ideal.

No. 484 Chemical Goggle, Clear Frame, Clear or Green Lens

No. 485 Chemical Goggle, Green Frame, Clear or Green Lens

No. 482 Clear Frame, Clear or Green Lens

No. 483 Green Frame, Clear or Green Lens

On hot jobs and in hot weather AO Sweatbands keep production *up*, accidents *down!* See your AO Safety Products Representative.



American Optical

SAFETY PRODUCTS DIVISION

†T.M. Reg. by American Optical Company

*The AO trademark, and the engineering and research in back of the trademark, are your assurance of optically correct eyewear with every AO goggle.

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

Now... your own painter can

"COLD-GALVANIZE"

any steel surface with

DIMETCOTE

* the 100% inorganic zinc coating

any **PLACE**

any **TIME**

any **WHERE**

SPRAY *or* **BRUSH**

Dimetcote is absolutely unique. It is not a paint, it contains no oils, resins or any other organic materials, yet it can be applied by spray or brush. When Dimetcote is applied to steel, a reaction takes place at the surface which produces chemical bonding as well as physical adhesion. It is almost impossible to find the interface between Dimetcote and the steel.

Dimetcote has many unusual characteristics. It shows no visible change after more than ten years exposure to the most severe weather conditions – sun, heat, fresh and salt water. It is insoluble in all solvents and petroleum products. It is highly abrasion resistant, but if abraded through to bare steel, the coating will cathodically inhibit corrosion.

Now tanks and structures can be given the same protection that galvanizing affords, *plus salt water resistance.* Existing structures need not be dismantled and new structures can be coated either before or after erection. *Only one coat* of Dimetcote over a sandblasted surface is required to protect such structures as:

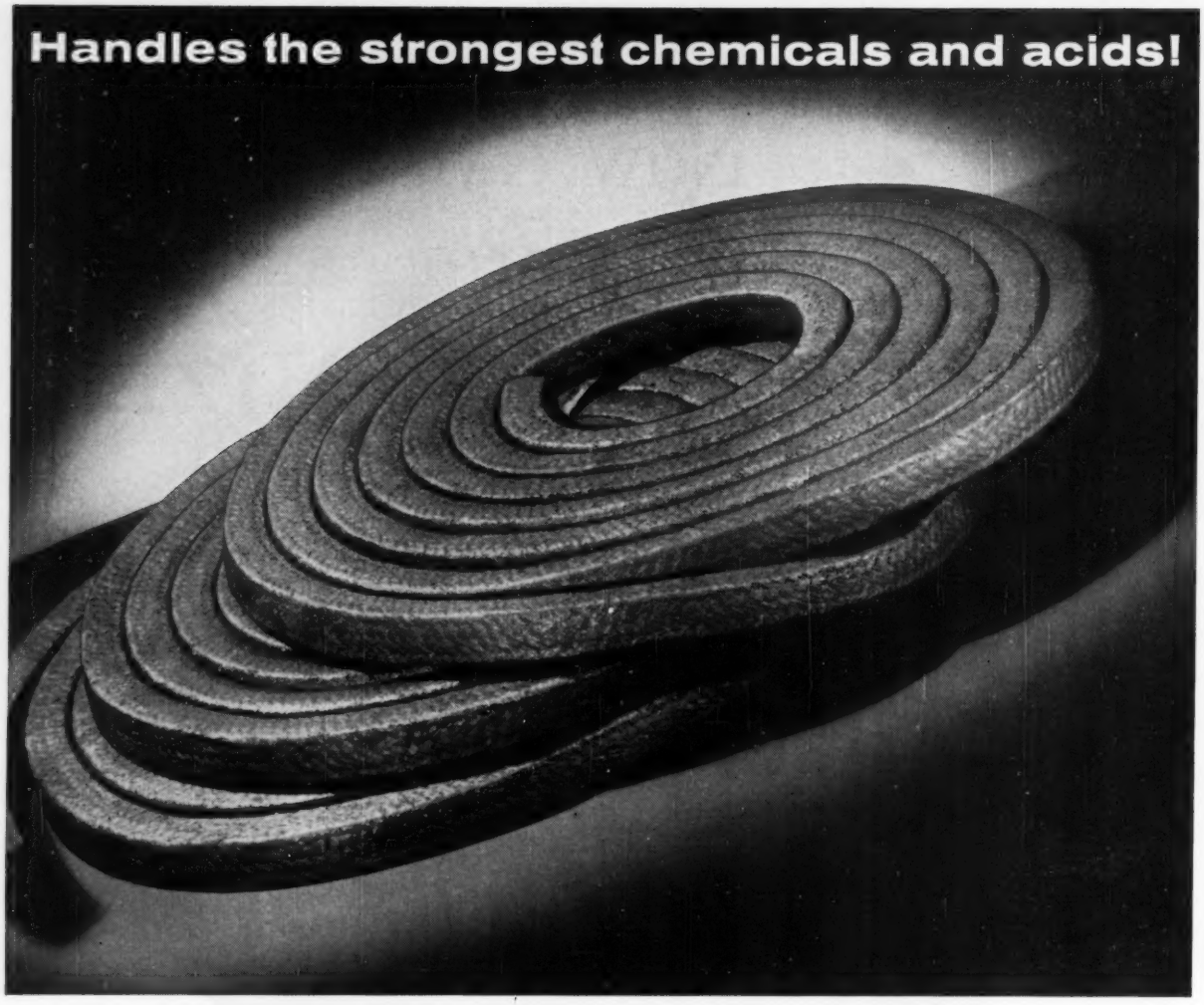
Tank Exteriors • Cargo Tanks in Tankers • Dam Gates • Structural Steel • Christmas Trees • Buoys • Floating Roof Tanks • Offshore Rigs • Water Tanks • Barges • Ship Decks • Stacks

Write for the Dimetcote Technical Bulletin today.

Follow the line of MOST resistance: Amercoat® CORPORATION

Dept. DG
4809 Firestone Blvd.,
South Gate, California

Evanston, Ill. • Kenilworth, N. J. • Jacksonville, Fla. • Houston, Tex.



Teflon-impregnated
U. S. Braided Asbestos Packing

U. S. TEFLON-impregnated braided asbestos packing is designed for service on reciprocating rods and plungers, valve stems, and centrifugal pumps handling corrosive acid and caustic solutions. TEFLON is completely inert in the presence of almost *all* chemicals. The long-fibre asbestos yarn braided into coil form is thoroughly impregnated with TEFLON and provides the proper density, minimizes friction and wear of rods or shafts.

U. S. 35% TEFLON-impregnated braided packing comes in 2 styles: No. 135 (White Asbestos) for handling light acids, caustics and all chemicals. No. 134 (Blue Asbestos) for handling chemicals of a higher concentration. Order from any of our 27 strategically-located District Sales Offices, selected distributors, or write address below.

"U. S." Research perfects it . . . "U. S." Production builds it . . . U. S. Industry depends on it.

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting



"Cracked" Ammonia shows tremendous cost saving and unsurpassed performance

1. Hydrogenation of fats and oils
2. Industrial furnace atmosphere for treatment of various metals and alloys
3. Process operations where 25% nitrogen diluent is not harmful

the Drever

Ammonia Dissociator

Produces clean 75% Hydrogen Gas Mixture

We can supply COMPLETE STORAGE SYSTEMS for tank car lots of anhydrous ammonia. This reduces the cost of ammonia approximately 75%. *Write for bulletin B-52*

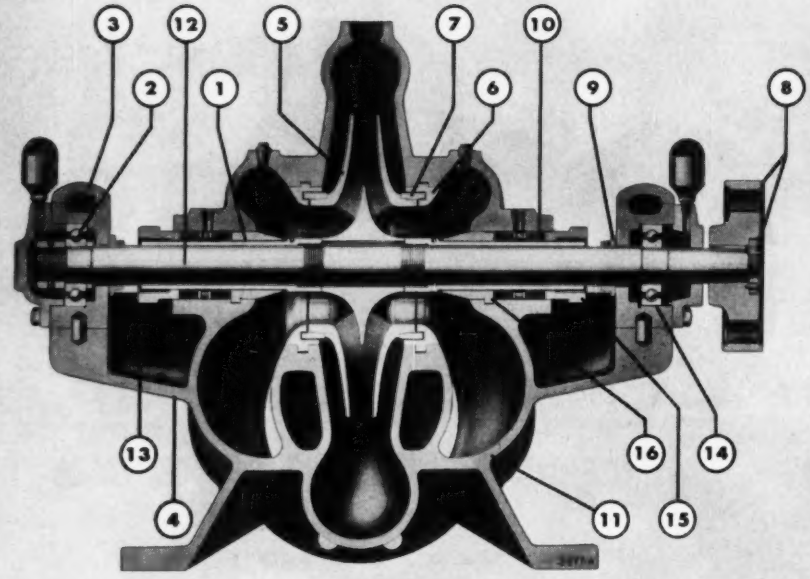
DREVER COMPANY

RED LION ROAD & PHILMONT AVE. • BETHAYRES, PA.

20

DE LAVAL
SINGLE STAGE
CENTRIFUGAL PUMPS

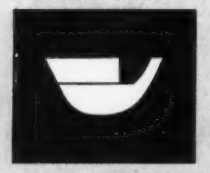
for dependable industrial service



Labyrinth wearing rings minimize leakage...maintain high efficiencies



Labyrinth rings used in these De Laval pumps retard flow of water through labyrinth passage.



Flat rings showing relatively unimpeded flow of water.

(1) **Shaft Sleeves** are screwed on, to abut the impeller and make a water-tight joint. Sleeve expands freely and independently of shaft when temperatures change. There is no tendency to buckle.

(2) **Thrust Bearing** locates rotor axially.

(3) **Bearing Caps** easily removable for maintenance.

(4) **Bearing Brackets** scraped to lining bars for perfect alignment.

(5) **Impeller** hydraulically balanced, finished on all surfaces.

(6) **Labyrinth Wearing Rings** held accurately in machined grooves in both case and cover.

(7) **Impeller Wearing Rings** threaded on impeller, opposite to rotation.

(8) **Flexible Coupling** ground on all exposed surfaces and statically balanced, complete coupling supplied, pump half mounted on taper so that it can be easily removed. Check nut locks coupling on taper.

(9) **Deflector** keeps water out of bearing.

(10) **Stuffing Boxes** extra deep; lantern rings for water sealing.

(11) **Pump Case** horizontally split; machined to limit gages.

(12) **Steel Shaft** ground to limit gages.

(13) **Drip Boxes** large; provided with drain openings.

(14) **Radial Bearing** free to move axially, thus avoiding temperature strains.

(15) **Glands** split horizontally.

(16) **Protecting Bushings** renewable.

You can count on the performance of the De Laval Single Stage Centrifugal Pumps because they are precision-made to high manufacturing standards and incorporate the many quality design features shown in the cross-section.

They operate at high or low speeds, at high or low heads...with maximum efficiency.

For example, De Laval G, I and K Single Stage Double Suction Pumps have a capacity range of 175 gpm to 6,000 gpm, and heads to 300 feet. They are available in sizes ranging from 4" suction and 3" discharge to 14" suction and 12" discharge. Write for Bulletin 1002.

DeLaval also furnishes larger centrifugals for capacities up to 70,000 gpm.

DE LAVAL *Centrifugal Pumps*

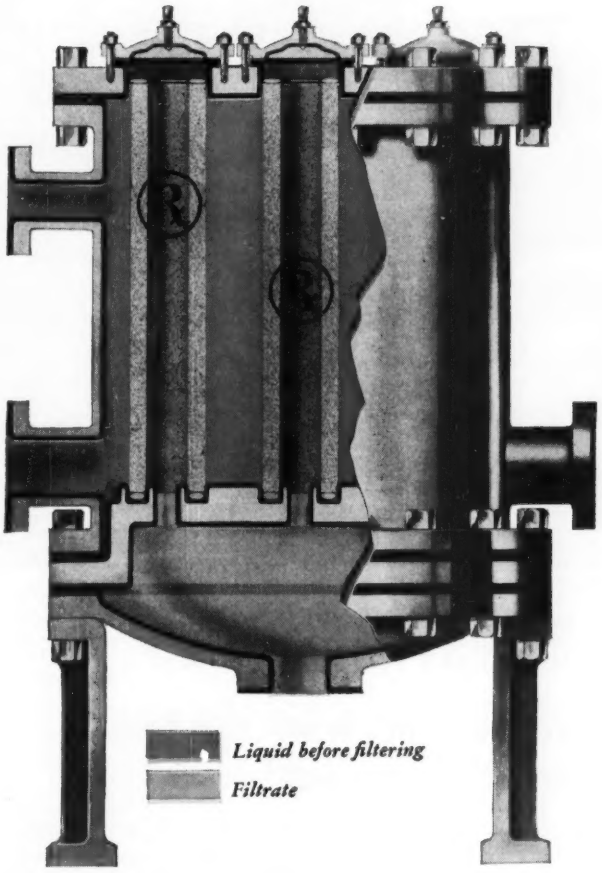
DE LAVAL STEAM TURBINE COMPANY

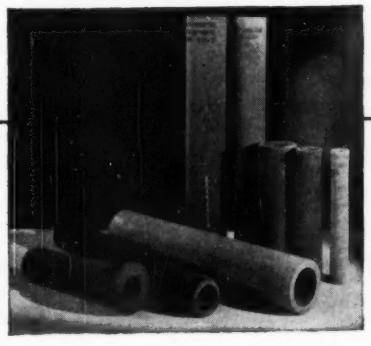
803 Nottingham Way, Trenton 2, New Jersey

DL 189

Another Norton Rx *on the job!*

Outstanding performance of Adams filters aided by Norton seamless porous tubes





R. P. Adams Co. Filters, covering many chemical filtering services, deliver sparkling clear filtrate and insure quick cleaning without disassembly. Adams filters handling acid or neutral solutions are equipped with Norton seamless porous tubes, *engineered and prescribed* for faster, more thorough filtering and backwashing.

Besides assuring fast, thorough filtering action, Norton porous tubes are extremely easy to clean by backwashing. Here are several good reasons why they excel in these two primary essentials of efficient, economical filter performance:

- Norton porous tubes are made of ALUNDUM* (fused alumina) *engineered* by Norton for chemical stability, inertness and other properties necessary to withstand acid, neutral and slightly alkaline liquors.
- Like all Norton ALUNDUM porous mediums they are made with the patented *controlled structure* process that assures even distribution of pores — for uniform passage of both filtering and backwashing liquids.
- They are *seamless,* providing unobstructed diffusion over their entire area — for further efficiency in both filtering and cleaning.

Other big advantages

of all Norton porous mediums include ease of installation and exceptional resistance to breakage and chipping. Available in sizes and open-pore ratios to meet your needs, they're *engineered* to last longer and cut your operating costs — and they're *prescribed* for a wide variety of chemical services, such as filtering water or solvents . . . cutting oils, wine, etc. . . . reclaiming cleaning fluids and industrial waste . . . and for boiler feed water treatment, carbonation, chlorination and other gas diffusion applications.

See your Norton Representative for further facts or write, describing your requirements, to NORTON COMPANY, 506 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON

REFRACTORIES

Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries



SIX DAYS OF DOWNTIME SAVED

Refinery tower cleaned chemically by Dowell in only eight hours . . . a six-day saving over mechanical methods!

A refinery operator had to shut down his H_2S stripper bubble cap tower every two months to remove an oily carbonate scale. Each shutdown took seven days, because of the mechanical cleaning methods used, and even then the tower was not thoroughly cleaned.

Dowell engineers were asked to tackle the problem. They cleaned the tower in just eight hours, using chemical solvents. Visual inspection showed the tower to be free of scale with all loose deposits washed from the caps and trays. The operator of this refinery was so impressed that he adopted a regular schedule of Dowell chemical cleaning.

Dowell chemical cleaning methods are designed to reduce costly downtime, because solvents are introduced through regular connections, keeping dismantling at a minimum. Liquid solvents can go wherever gases or condensates flow —to clean angles, bends and other irregular surfaces inaccessible to mechanical methods.

You can help to maintain maximum operating efficiency in your plant by arranging for a regular program of Dowell chemical cleaning. For full information, call your nearest Dowell office, or write Dowell Incorporated, Tulsa 1, Oklahoma, Department G-33.

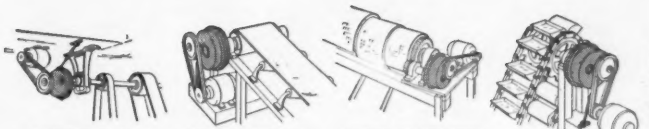
chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Falk ALL-STEEL Shaft Mounted Drives





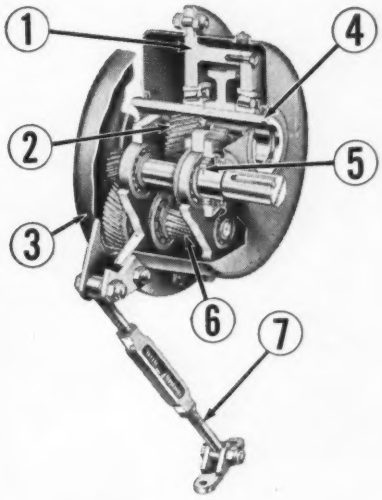
LINE SHAFTING | BELT CONVEYOR | GRAVEL CLASSIFIER | BUCKET ELEVATOR

APPLICATIONS UNLIMITED

The range of applications to which the all-steel Falk Shaft Mounted Drive is ideally suited is so wide that complete listing is impracticable. The sketches above are included only to indicate a few typical installations where considerable speed reduction in limited space is an important advantage.

SIX SIZES

- 1/2 to 30 hp
- Single or double reduction
- Wide output speed range—420 to 10 rpm



These versatile, NEW speed-reducing units

save space, power, material and time

Here is the economical solution to the countless application problems requiring efficient speed reduction in limited space! The new Falk all-steel Shaft Mounted Drive—a modification of the universally-accepted Falk Motoreducer design—embodies many exclusive structural and functional features which add up to better service, longer life and substantial savings.

This rugged, compact drive mounts directly on the driven shaft—a distinct saving in floor space. Its precision Falk helical gearing gives highest mechanical efficiency, with a resultant power saving. No adjustable motor bases or slide rails are required. Installation is simple and rapid—output speeds can be quickly changed; thus time is saved...Write to Department 247 for engineering bulletin, including selection and dimension details.

FALK "In-Built" Factors... that give maximum efficiency, convenience and dependability

1 **All-steel Frame,** with more than double the rigidity of iron, supports all rotating elements.

2 **Precision Helical Gears,** designed and machined by Falk, rated to AGMA standards.

3 **Pressed Steel Housings,** whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.

4 **Through Hollow Shaft** with counter bore provides for easiest installation or removal from driven machine shaft extensions.

5 **Backstop** can be furnished with the unit or added later for positive prevention of reverse rotation.

6 **Positive Lubrication,** continuous direct dip of revolving elements at all speeds.

7 **Tie Rod** and turnbuckle serve as anchor and facilitate V-belt or chain adjustment.

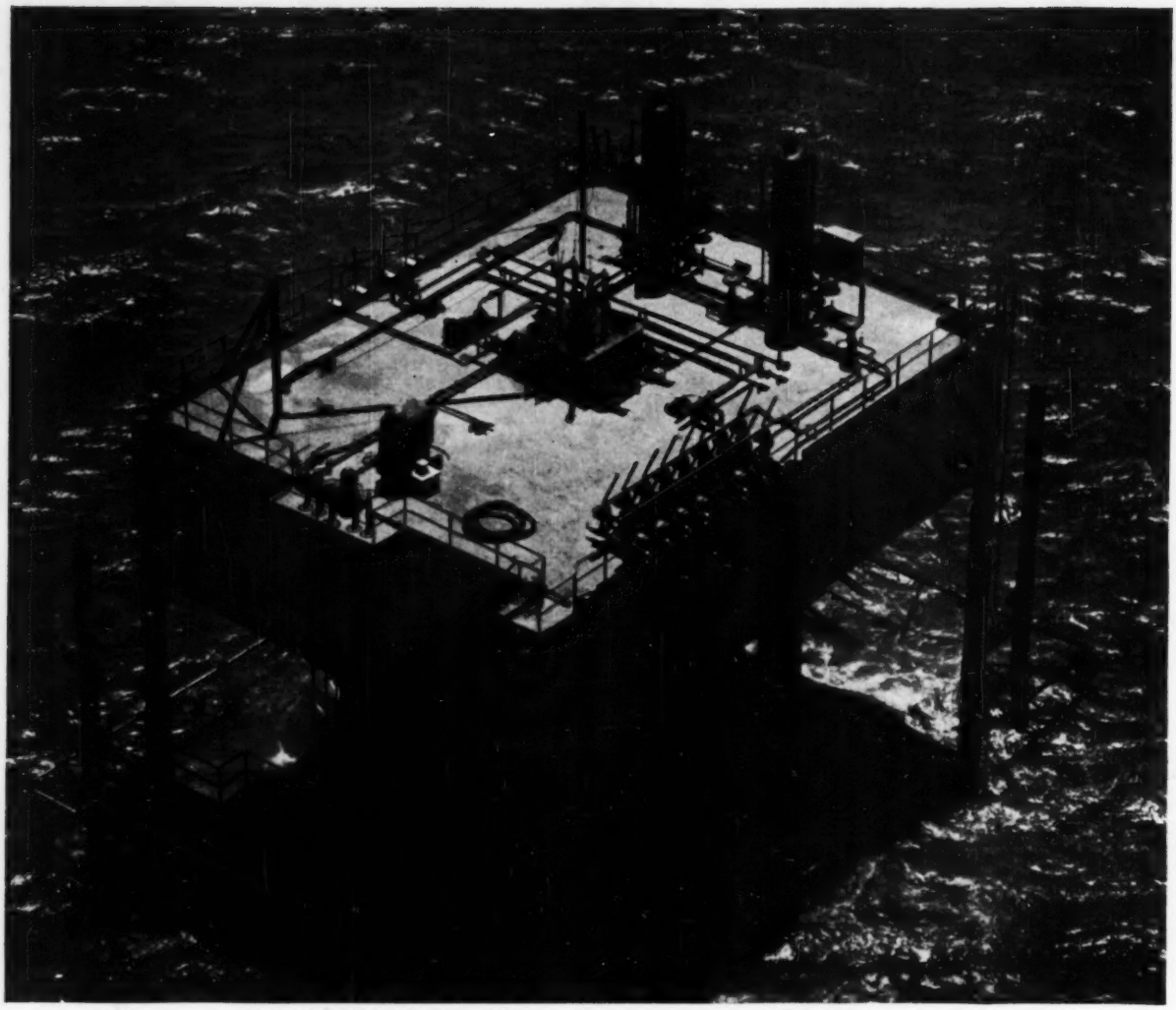
THE FALK CORPORATION, Milwaukee 8, Wisconsin

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

FALK

...a good name in industry



A Bethlehem-built Tank Battery Barge on location at an off-shore site.

Bethlehem's Submersible Oil Storage Tank Battery Barge

FOR THE MOST ECONOMICAL AND EFFICIENT INTERIM STORAGE OF CRUDE IN SHALLOW WATER OR MARSHLAND

- Storage Capacity to Suit Your Requirements.
- Complete with Pumps, Oil and Gas Separators and Compressors.
- Eliminates Need for Costly Erection Crews Miles from their Base.
- No Piling to Move or Cut when Moved.
- Mobility, if and when Necessary . . . with 100 per cent Salvage.
- Leakproof . . . Solves Pollution Problem.

Our engineers will be happy to survey your needs and make specific proposals.

SHIP REPAIR YARDS

Boston Harbor — New York Harbor
Baltimore Harbor — Beaumont, Texas
Los Angeles Harbor — San Francisco Harbor

SHIPBUILDING YARDS

Quincy, Mass. — Staten Island, N. Y.
Sparrows Point, Md. — Beaumont, Texas
Terminal Island, Calif. — San Francisco, Calif.

BETHLEHEM STEEL

Shipbuilding Division

GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N. Y.

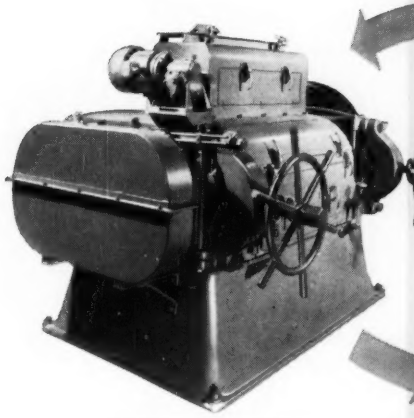
On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation



ALLIS-CHALMERS
PROCESS SYSTEM

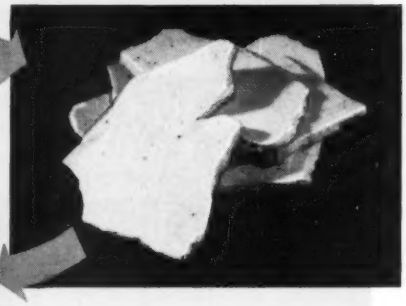
Converts Fine Particles Into

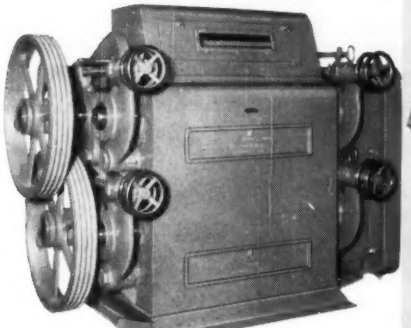
Granular Product To Meet Consumer Demand



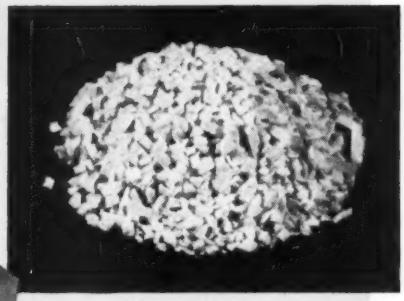
Compacting Mill

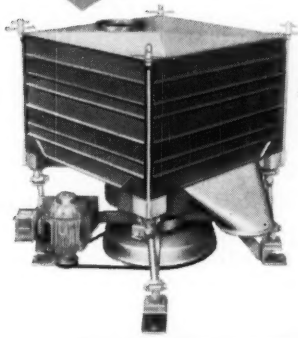






Roller Mill





Circle Sifter

1 Recovery operation starts with unacceptable minus 30 mesh chemical salt — fines created in original process.

2 An Allis-Chalmers heavy duty compacting mill is the principal component in the recovery system. The flakes or slabs illustrated are the result of mechanical densification in the compacting mill. An Allis-Chalmers two-pair high corrugated roller mill is used to granulate flakes. Final separation is made in the *Circle* sifter — an Allis-Chalmers gyratory screen. An 80% to 90% recovery of salable product is effected.

3 The resulting granules (100% minus 3 mesh and 100% on 10 mesh) equal or surpass natural product in every respect. Reconstituted product differs little from parent product in abrasion tests. Other tests have proved the compacted granule superior in controlled solubility. Granulated product is more uniform in particle size, flows more freely and has better "eye-appeal."

A-4743

For complete information, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 25C6177J.

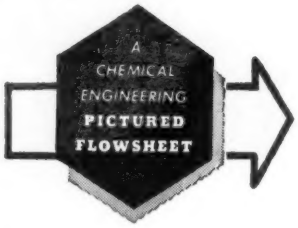
Circle is an Allis-Chalmers trademark.

ALLIS-CHALMERS

WHAT DEMAND HAS DONE TO:

Ammonium Nitrate

New and improved processes now turn out large quantities of this important fertilizer chemical.



Out of the expanding, bustling fertilizer industry has come much in the way of new and improved processes. One of the best examples of this centers around the manufacturer of a most important member of the fertilizer family: ammonium nitrate.*

From intensive and very recent developments, there has evolved three commercially important processes for ammonium nitrate production: the Stengel process, the prilling process and the crystallization process (see flowsheet).

There are similarities between the three:

All start with ammonia and nitric acid. All the latest nitrate units are located in ammonia plants. This location makes for a well integrated arrangement: nitric acid is produced by oxidation of ammonia; ammonia and nitric react to form ammonium nitrate.

But there are important technical differences:

In the Stengel process ammonia and nitric are reacted under conditions that produce a substantially dry product coming out of the reactor. Molten nitrate is solidified on continuous water-cooled belts, and flakes are formed in a breaker.

In prilling, some drying takes place during nitrate formation, but further removal of moisture takes place in a vacuum evaporator; granules of nitrate are formed in a prilling tower.

The crystallization process also only partially removes moisture with the heat of reaction. A nitrate solution is then cooled, and crystals formed in a vacuum crystallizer.

1 Stengel Process

This process is practiced at the Sterlington, La., plant of Commercial Solvents.

Ammonia vapor (290 F) and 60% nitric acid (330 F) form ammonium nitrate in a packed reactor at about 400 F. From the packed section, steam and nitrate go to a cyclone-type separator. A recovery system (entrainment separator and condensers) recover any nitrates in the vapor stream.

Ammonium nitrate collects at the bottom of the separator, while a stream of heated air flows up through the molten nitrate, lowering the moisture content to about 0.2%. Leaving the bottom of the separator, ammonium nitrate goes to a weir box, and from there to water-cooled Sandvik belts. These are 31½-in. wide, made of stainless steel. A sheet of ammonium nitrate forms here and is carried to the end of the belt. The sheet falls into a breaker, where flakes are formed.

From there, the flakes go to grinders, screens and to a coating drum.

Prilling Process

The Barton Plant of Lion Oil Co., near New Orleans, La., is a good example of the prilling process.

In a typical operation, ammonia and nitric acid react in a neutralizing vessel under agitation. The heat of reaction is used to drive off some moisture—the solution has a strength of about 85% coming out of the neutralizer.

The substantially neutral solution is pumped to a vacuum concentrator, where a liquor of about 95% ammonium nitrate forms. From there flow is to a 208-ft. high prilling tower. Here a fine spray of droplets flows downward against a stream of conditioned air. As the material falls it solidifies into small pellets.

The pellets contain some moisture at this point. Final drying is accomplished in rotary dryers. Cooling and coating complete the process.

3 Crystallization Process

Latest example of this operation is the Iceland plant of Aburdarverksmidjan H.F. (See C. E., Aug. 1954).

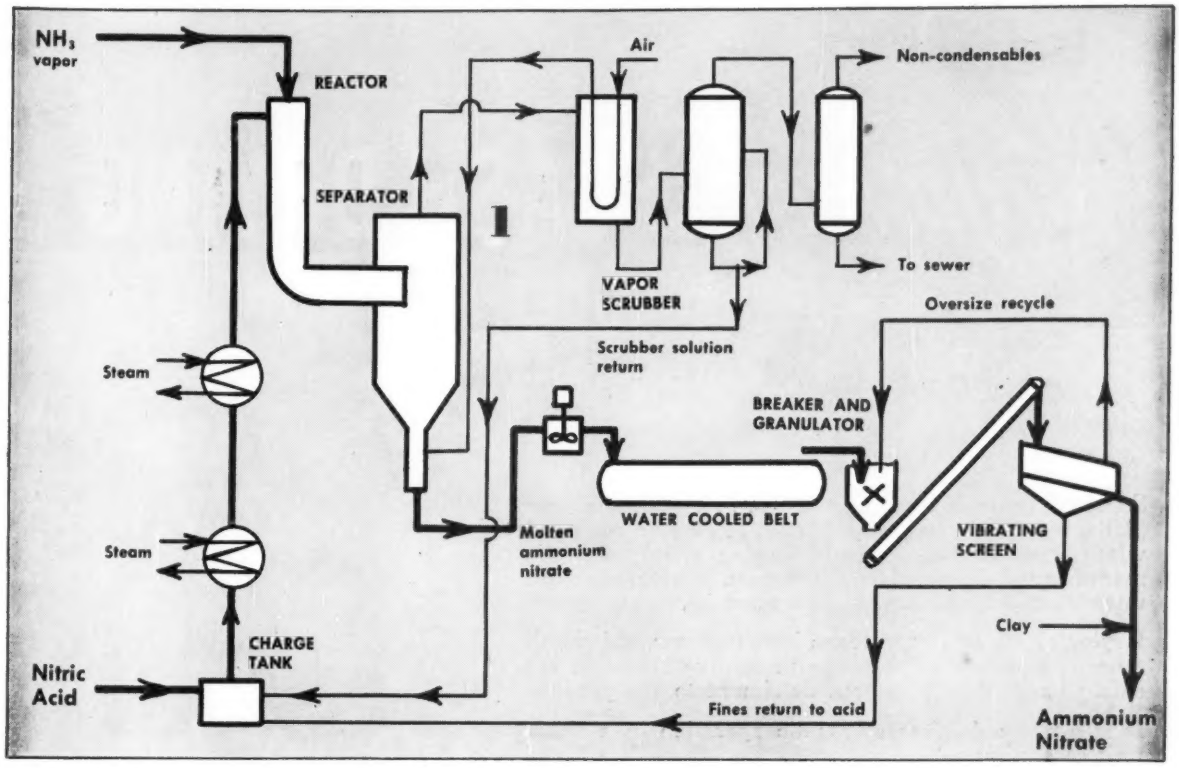
Here ammonium nitrate is formed in a vacuum concentrator. The reactants are nitric acid, and ammonia dissolved in mother liquor. Heat developed by the reaction is used to evaporate water under vacuum.

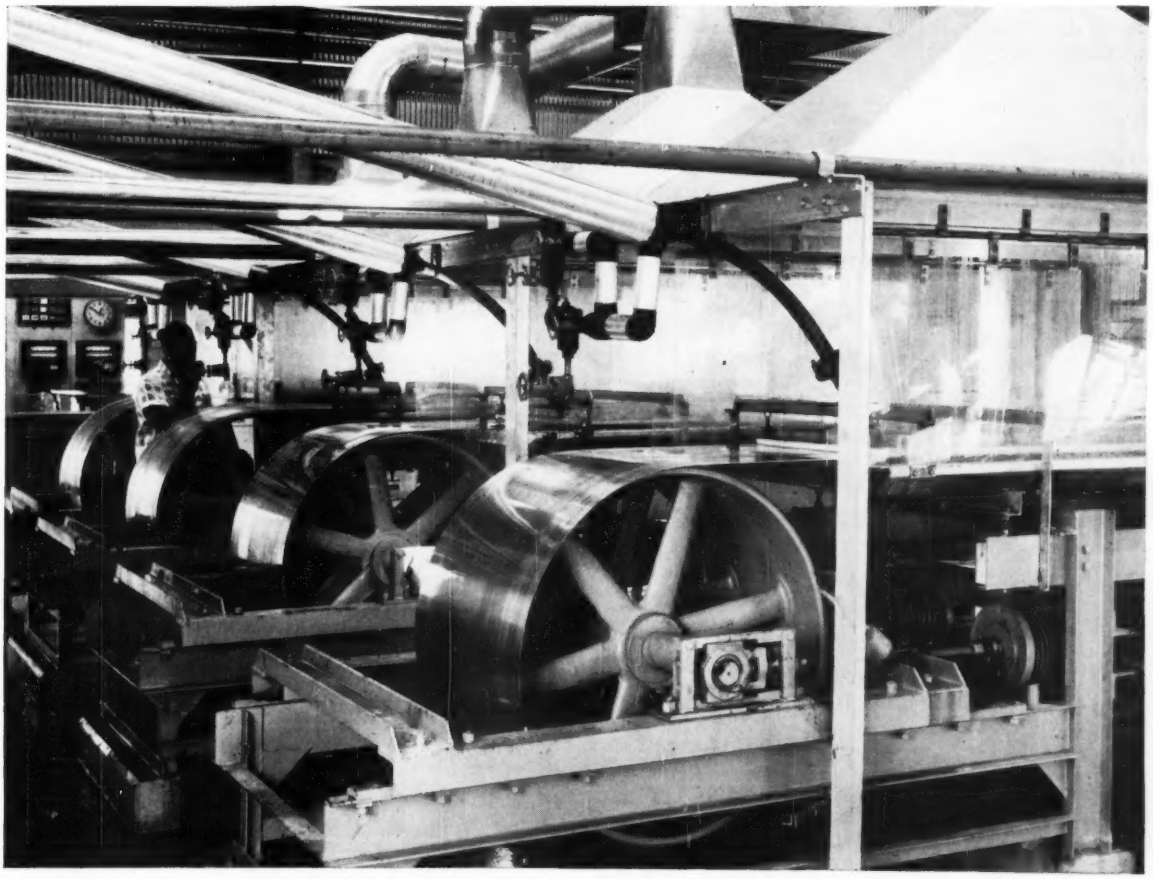
Main flow is then to a surge tank, and to a vacuum crystallizer. The solution enters the crystallizer saturated at 125 F.

Under vacuum, the solution cools to 97 F, and crystals form. The ammonium nitrate slurry goes to a crystal feeder, and from there to a centrifuge. Mother liquor is recycled first to the ammonia absorber, then to the concentrator.

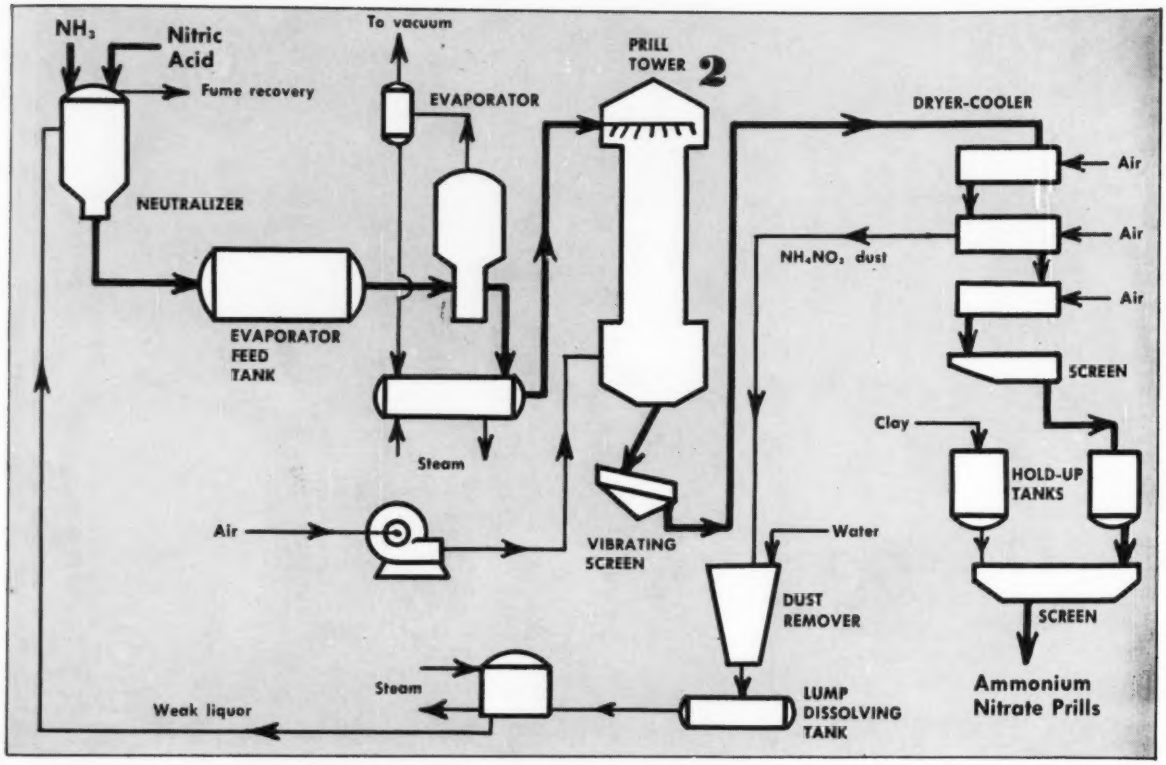
The crystals are treated in a rotary dryer, cooled, coated and bagged.

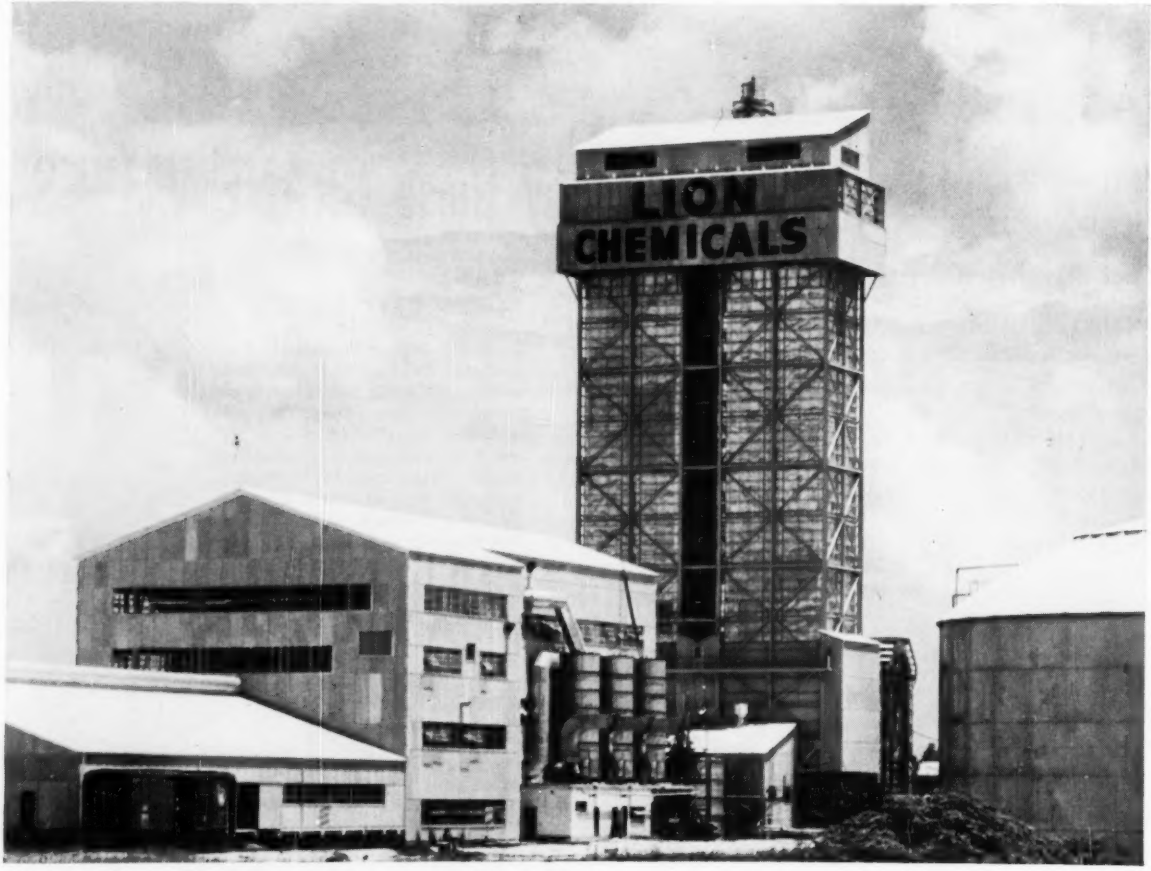
* About 1.86 million tons produced in 1954 for all purposes (100%), of which 1.62 million tons was fertilizer-grade.



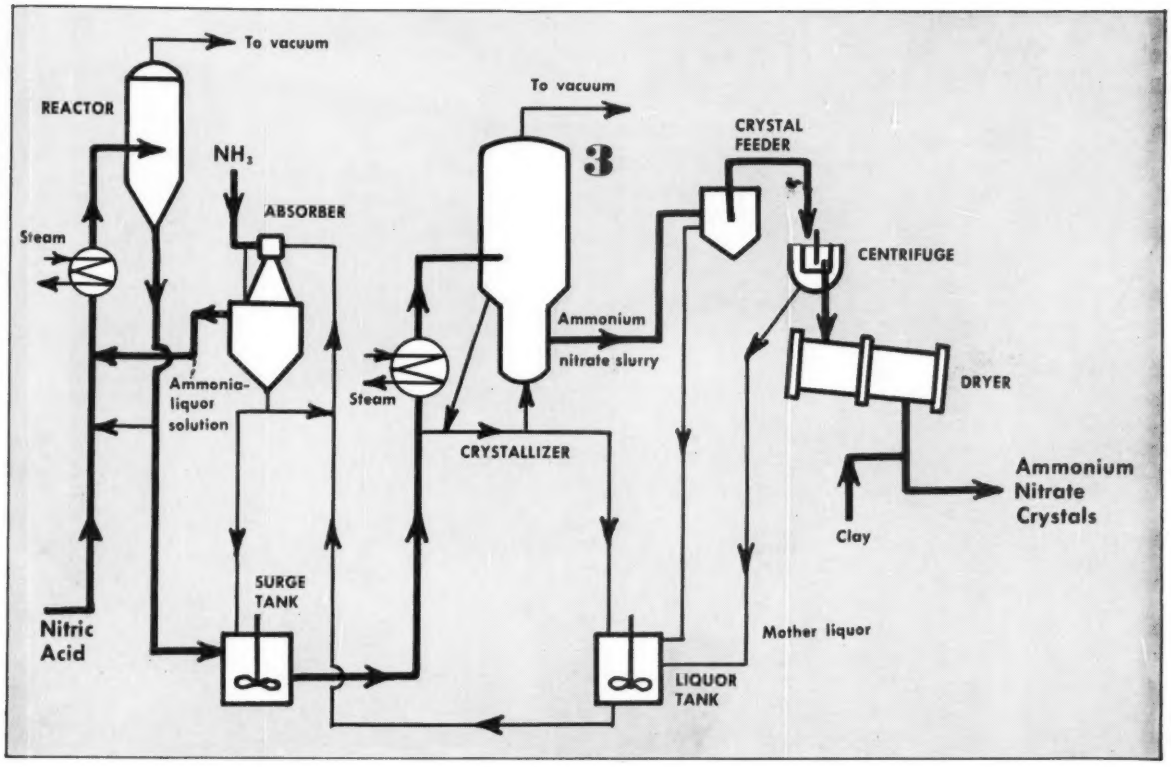


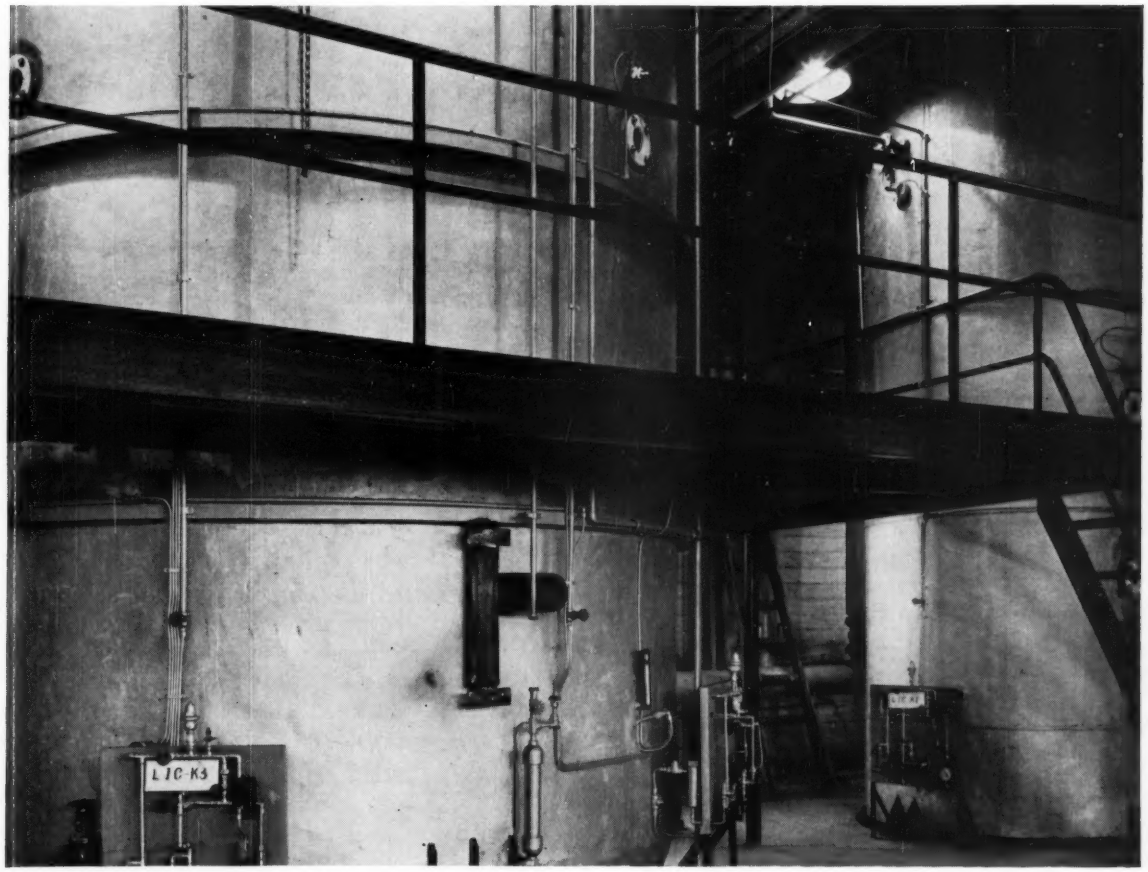
1 STENGEL PROCESS features stainless steel belts, where molten ammonium nitrate—from the reactor—solidifies in thin sheets. These sheets are then broken up in a breaker and granulator. (Commercial Solvents)



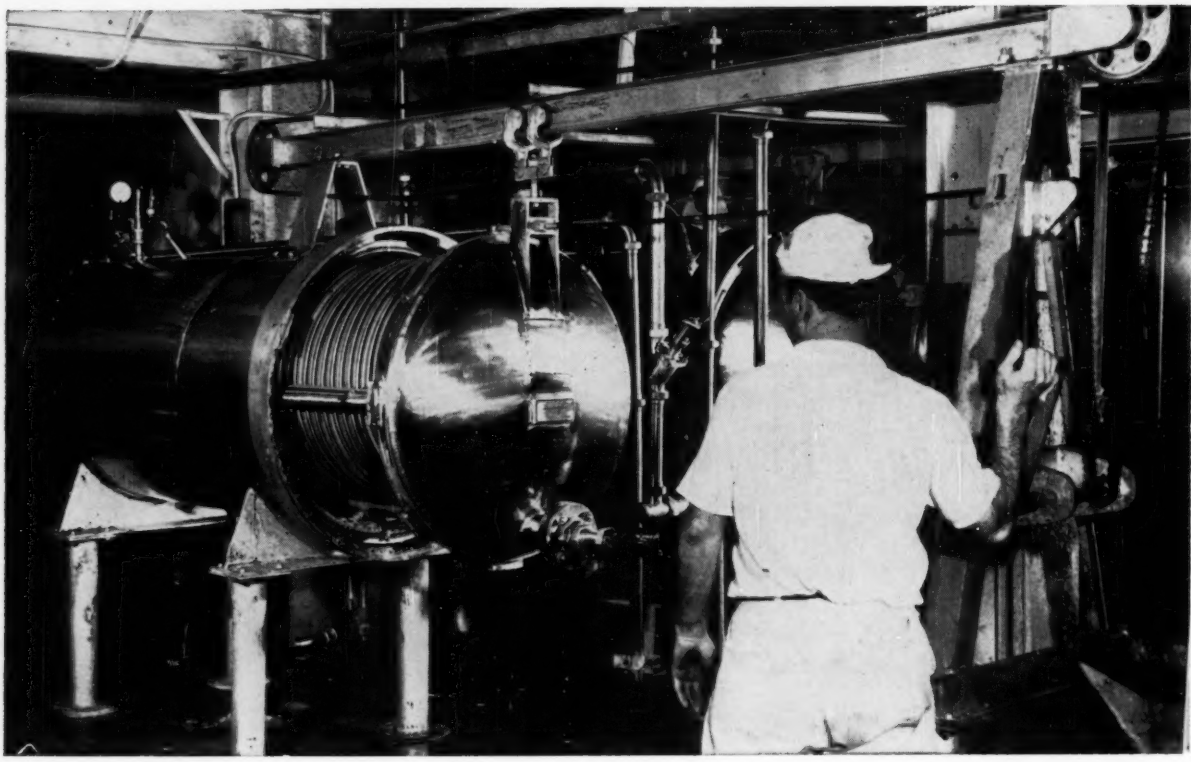


2 **PRILLING PROCESS** centers around a prilling tower, where a concentrated solution of ammonium nitrate forms into small droplets, which flow downward against a stream of air. (Lion Oil)





3 **CRYSTALLIZATION** features a vacuum crystallizer, where a saturated solution of ammonium nitrate is cooled under vacuum. The slurry then goes to a centrifuge. Final moisture removal is handled in a dryer. (Aburdarverksmidjan H.F.)



1 MAN does the work of 3 with this efficient horizontal filter

One man can easily operate several Niagara Horizontal Filters . . . producing as much as three men operating old fashioned filter presses.

Here's why: A Niagara Horizontal will filter to clarity at rates up to 45,000 G.P.H. Flow rates are two to five times greater than those of old style cloth covered presses. A Niagara can be taken off stream, drained, opened, cleaned, closed, filled and precoated . . . by one man . . . in a matter of minutes, not hours. And there's no time lost installing cloths . . . no cloth washing . . . no cloth expense.

Result . . . maximum filtration efficiency . . . greatly reduced operating time . . . minimum downtime . . . with costs reduced in proportion.

When you have a combination like this . . . improved filtration, faster, for less money . . . it's easy to see why your Niagara Horizontal Filter will quickly pay its entire cost through direct savings. Ask any of the hundreds of Niagara users. You'll get the same story.

Niagara Filters, both horizontal and vertical, are available in a wide range of capacities and can be made of stainless steel or other alloys for corrosion resistance. And Niagara users are served by filtration specialists located in 27 cities from coast to coast.

Want details? Just clip and mail the coupon.

NIAGARA ENGINEERS ARE FILTRATION SPECIALISTS

They've had years of experience. They'll study and analyze your filtration problems . . . test your samples . . . pilot the filtration . . . and build a Niagara unit to meet your most exacting requirements.

Niagara Filters
DIVISION
AMERICAN MACHINE AND METALS, INC.
DEPT. CE755, EAST MOLINE, ILLINOIS

In Europe: Niagara Filters Europe, Post Box 1109, Amsterdam-C, Holland

YES . . . we'd like to know more about Niagara Pressure Leaf Filters for _____

☐ Send new catalog NC-1-53 ☐ Have representative call

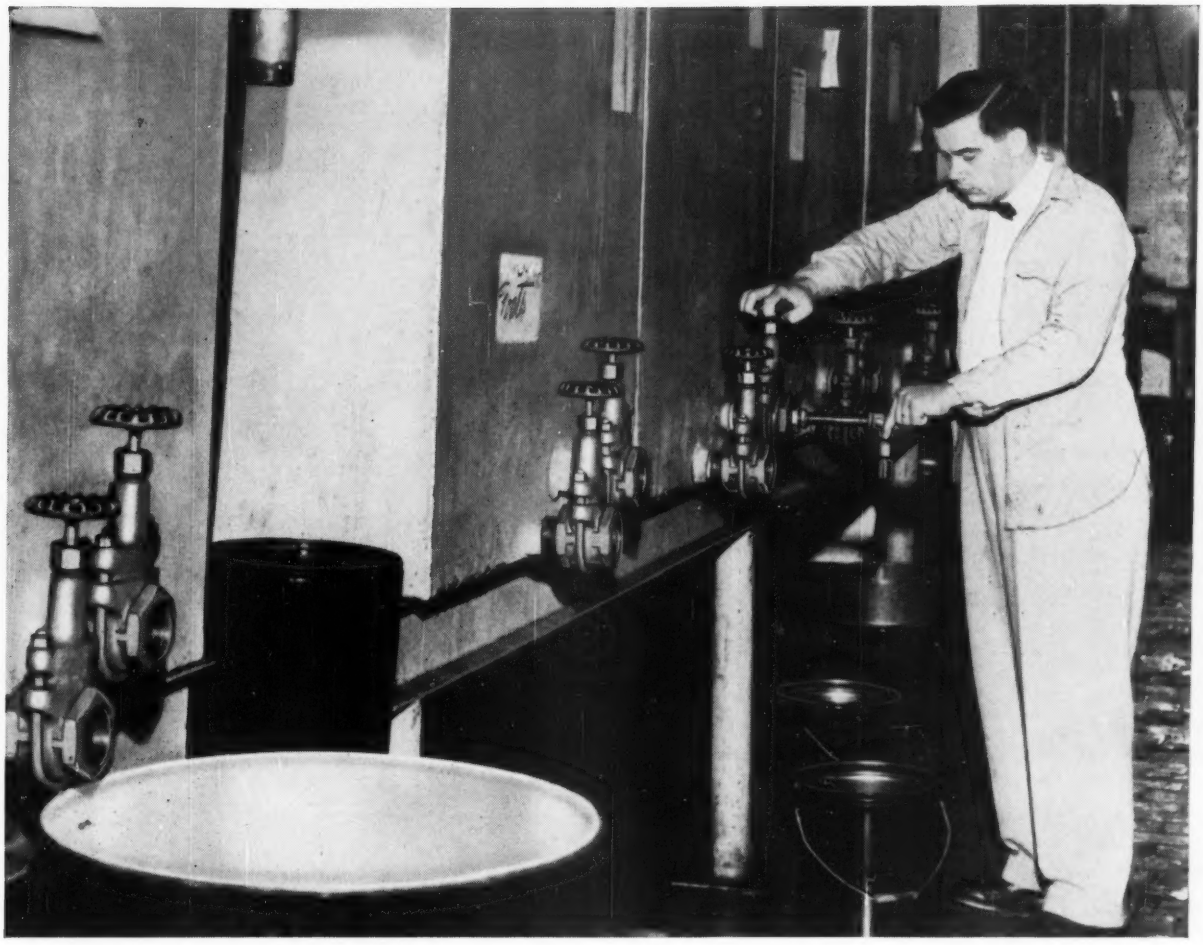
Name _____

Title _____

Company _____

Address _____

City _____ Zone ____ State _____



Leakage troubles here stopped by these CRANE VALVES

THE CASE HISTORY—Read why Hysan Products Co., Chicago, changed to Crane Clamp Gate Valves in all process and storage piping. Hysan makes liquid waxes, pine oil and coal tar disinfectants, liquid soaps, and similar chemical specialties.

Valves formerly used were similar to Crane Clamp Gates, but only in appearance. They lasted no more than 2 to 6 months—leaking at seats and disc with no more than 3 to 12 operating cycles daily. Maintenance and replacement costs mounted—as did down-time losses. The leaky valves on tank lines forced repeated transfer of storage stocks. As many as 3 men were needed to make valve repairs.

All this trouble stopped when the plant installed Crane No. 488 Clamp Gates. After almost 2 years' service, these valves show no sign of wear or leakage. An occasional pull-up on the packing is all they need—and one man handles all piping maintenance.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

CRANE
CLAMP GATE VALVES

Rugged design with careful, close tolerance machining, especially on seating surfaces, sets these Crane valves apart from others. They give long-lasting tight closure under frequent operation and on hard-to-hold fluids. Many patterns to choose from—all-iron or brass-trimmed. See your Crane Catalog or Crane Representative.





VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

Raymond FLASH DRYING

For Modern Production of Powdered Materials

Standard types of Raymond Mills . . . including Roller Mills, Imp Mills and Cage Mills . . . may be equipped with Flash Drying Accessories for simplifying the manufacture of powdered products, where moisture must be removed from the raw material.

Drying of the fine particles is instantaneous and simultaneous with pulverizing. Heat sensitive materials are safely handled and without detriment to the product.

It is a clean dustless automatic operation in a single unit of equipment.

For processing chemicals, pigments, synthetic resins, foodstuffs, filter cake, clays, industrial wastes and special products, the Raymond system offers important advantages:—



RAYMOND IMP MILL with Flash Drying



RAYMOND CAGE MILL with Flash Drying

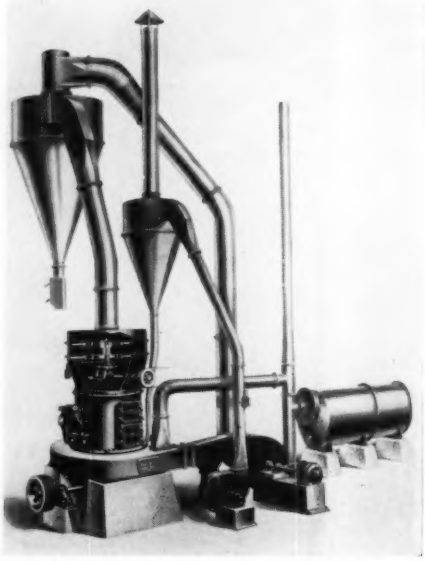
Flexible installation readily adaptable to any plant layout

Close product control in dryness, fineness and temperature

Simplified material handling plus economy in supervision, operation and maintenance

Refer your problems to Raymond engineers for definite recommendations.

Ask for Catalog No. 54-A.



RAYMOND ROLLER MILL with Flash Drying

COMBUSTION ENGINEERING, INC.

Raymond Division

1311 North Branch St.
Chicago 22, Illinois

Sales Offices in Principal Cities

Allan J. Greene: Man of the Month

Chemical engineer is elected to the board of directors of Chas. Pfizer & Co., Inc.



In the pharmaceutical industry, where product obsolescence is the norm and today's sales leader may easily be passed by something still newer tomorrow, the man who decides on the launching of a new product plays a big role in a company's success. In recognition of the importance of this role Chas. Pfizer & Co., Inc., has named Allan J. Greene, its director of commercial development, to its board of directors.

A chemical engineer, Al Greene came to his seat on Pfizer's board from the research and development department by way of production and commercial development.

▶ **Production Man**—Associated with the 106-yr.-old firm throughout his career, Al spent most of his time in the production departments. After getting his BS in ChE from Yale in 1938, he joined Pfizer's research and development group and did pilot plant work. Before long he became a production supervisor at the company's main plant in Brooklyn, N. Y.

Two years later, Pfizer put him in charge of its citric acid fermentation department and in 1949 the company made him assistant plant superintendent.

Within a year, Al became general production manager for the company.

Last August, he moved out of production to take on his current job as director of commercial development, with the important responsibility of coordinating the development of all of Pfizer's new products. Al credits his production background with giving him the experience in handling people and dealing with tough situtations that has been most useful as an executive.

▶ **Building Background**—Production supervision, he contends, equips the engineer with a "feeling" for planning and a respect for the tangibles—equipment, quality controls, etc. It also gives him a chance to learn how to work with and through people.

"Developing these abilities is an essential part of the engineer's growth. A man soon learns that the only way to get the people working for him to respect his leadership is by showing them accomplishments—you only get by on your record. It's good training for any engineer, but especially for those who look forward to management," he contends.

▶ **Learn Business**—Al also believes that the engineer who aspires to and executive post should acquire, as early as possible, a "business sense."

Pfizer's new director learned most of his business lessons from on-the-job experience and by reading a slew of books dealing with all phases of business and management activities. Recently he broadened his training by attending the Advanced Management School of the Harvard Business School.

▶ **Don't Worry**—To younger engineer, Mr. Greene offers one bit of advice: "Don't worry about when you'll be president, do your present job well and make yourself ready to step into the next job—then you'll have nothing to worry about."

Still on the subject of getting ahead, Al maintains that the two most important factors are hard work and being in the right place at the right time. He cites his own career as evidence. "I came with Pfizer," he says, "when it was a very small company. As late as 1943 annual sales were only $27 million. Then the company launched an expansion program which has resulted in a tremendous growth and boosted sales to over $145 million per year. This, of course opened up new opportunities for me at a time when I had the proper background and sufficient experience to take advantage of them. Timing and work seem to me to be basic to success.

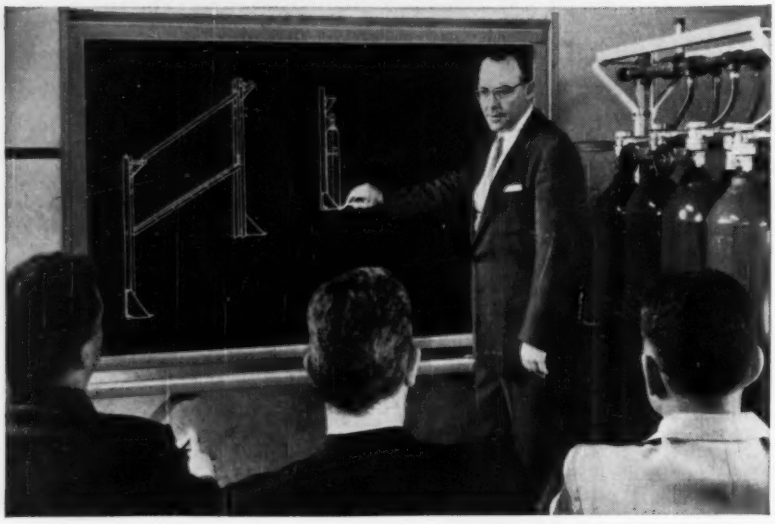
"In addition, at Pfizer we have an aggressive and relatively young management group, sympathetic to the aspirations of the individual. It spends considerable time helping men develop their talents to the fullest. The company's rapid growth attests their success in this."

▶ **Once Links Champ**—As usually happens, however, greater success in business accompanies higher scores on the golf course. Al was once Pfizer's top golfer, now he ruefully admits that his scores are "about 20 strokes" higher than they once were.

The fact that the Greenes bought a boat about three years ago and now spend summer weekends on Long Island Sound instead of on the links may have something to do with it too. For Al, his wife and their two girls (12 and 5) sailing is tops in recreation.—HTS

Names in the News continued on p. 328

GREATEST FIRE FIGHTING DESIGN ADVANCE IN 25 YEARS!



This Kidde Automatic Pressure-Operated CO_2 Extinguishing System is *brand new from the floor up!*

✓ CHECK THESE 10 FEATURES!

☐ **1. NO FALLING WEIGHTS**—No clumsy mechanical triggering methods. Pneumatic or Electrical Control Heads automatically trigger CO_2 cylinders, assure complete discharge!

☐ **2. SELF-ENCLOSED PARTS**—All moving parts of the new Kidde system are self-enclosed to prevent fouling or accidental operation!

☐ **3. EASIER INSTALLATION**—New racking arrangement is pre-drilled at the factory, eliminates need for special hangers, tools or outside material! Can be either "free standing" or wall mount.

☐ **4. NO PARTS TO REPLACE**—Even after a fire, operating parts of the new Kidde system can be re-set with a screwdriver. No parts need be replaced. Refill cylinders and system is ready for operation!

☐ **5. SIMPLE, THOROUGH TESTING**—By merely disconnecting control heads from cylinders, *all* operating parts (other than actual discharge of CO_2 gas) can be tested *in place!*

☐ **6. QUICK VISUAL INSPECTION**—All primary actuating parts fitted with easy-to-read visual indicator. Shows at a glance if system is "set" or "released."

☐ **7. MULTIPLE PROTECTION**—Automatically-operated Directional Valves let you protect more than one hazard from the same bank of cylinders!

☐ **8. SIMPLIFIED WEIGHING**—New racking arrangement lets you weigh CO_2 cylinders right in place without disconnecting them, providing uninterrupted fire protection even while cylinders are being weighed!

☐ **9. NO OUTSIDE POWER NEEDED**—The new Kidde system is completely self-contained, has rate-of-temperature-rise detectors which give sure protection even in case of outside power failure!

☐ **10. AUXILIARY EQUIPMENT**—Also available for use with the new Kidde system are devices for turning power on or off, for opening or closing doors, windows, dampers, etc.

Fully approved by Underwriters' and Factory Mutual Laboratories.

Complete details of this revolutionary new system are contained in Kidde's Pressure-Operated System Booklet. Write for your copy today!

Kidde (K Kidde) **Walter Kidde & Company, Inc.**
728 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

NAMES . . .

George T. Deck—Plant manager of the new American Lithium Chemicals, Inc., $6.6 million plant near San Antonio, Tex.

Edward D. Porter—Manager of the new electric furnace plant which Norton Co. is building at Huntsville, Ala. **J. Zach Higgs** is superintendent of the new plant.

Royal V. Prevallet—Plant manager for Stanley Drug Products, Inc., Portland, Ore., drug and vitamin manufacturer.

Robert F. Elder—Executive vice president of Plax Corp., Hartford, Conn., manufacturer of plastic bottles and plastic film and sheeting.

Harold Rafson—Project leader in engineering research at the central laboratories of General Foods, Hoboken, N. J.

John A. Wiedmann—Director of research and development at A. W. Cash Co., Decatur, Ill., producers of automatic valves, controllers, governors and regulators.

Frank W. Glaser—Vice president and director of Alloy Precision Castings Co., Cleveland, O. In his new post, Mr. Glaser will be in charge of new development work, engineering and production operations. He was formerly vice president in charge of research and development for American Electrometal Corp.

Arthur L. Mullaly—Vice president of Carlisle Chemical Works, Inc., Reading, O. Mr. Mullaly is executive vice president of Advanced Solvents and Chemical Co., a wholly owned subsidiary of Carlisle.

George Granger Brown—Awarded an honorary degree of doctor of engineering by New York University College of Engineering. Dr. Brown is dean of engineering at the University of Michigan.

Henry B. Hass—Awarded the 1955 Honor Scroll of the New York Chapter of the American Institute of Chemists. Dr. Hass, president of Sugar Research Foundation, Inc., received the scroll as a tribute to his advancement of petrochemicals and pioneering in the new field of sucrochemistry.



Howard S. Bunn

Howard S. Bunn has been elected vice president and member of the executive committee of Union Carbide and Carbon Corp. He has been a member of the organization since 1922. After serving as manager of Pyrofax gas division and later the plastics division of Carbide and Carbon Chemicals Co., Mr. Bunn became successively vice president of that company and vice president and president of Bakelite Co. In April, 1953, he was elected a vice president and in September, 1954, a director of Union Carbide.

K. D. Nichols—Awarded the AEC's Certificate of Distinguished Service. Maj. Gen. Nichols (U. S. A. ret.) was former general manager for the Atomic Energy Commission.

Lewis W. Cabot—A director of Arthur D. Little, Inc., Cambridge, Mass. Mr. Cabot is vice president, treasurer and director of Godfrey L. Cabot, Inc., and its subsidiaries.

George E. Brandon—Retired as general manager, Semet-Solvay

are chemicals **EATING UP** your packing dollars?

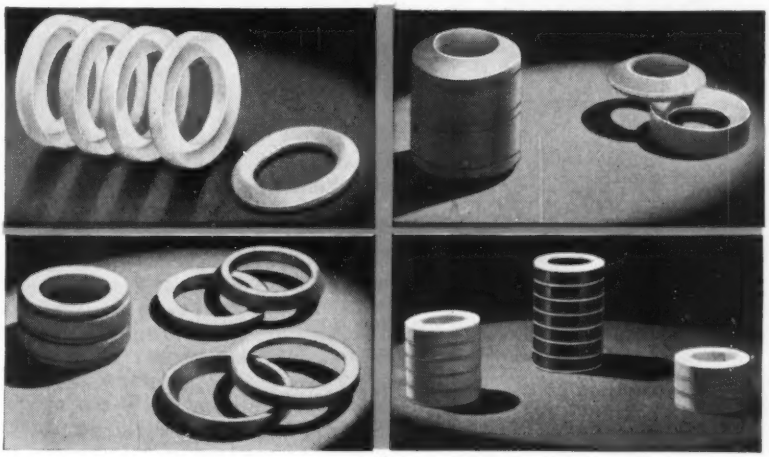
Get Chemiseal Packings that last months instead of hours. Packings that won't deteriorate, won't contaminate, won't "freeze" shaft action because they are made of TEFLON —impervious to practically all chemicals.

V-TYPE PACKING

Chemiseal Type 810 TEFLON V-Packing for use in manual, air or motor operated valves. Distinctive tapered V design offers greater flexibility and resiliency, providing necessary seal at low gland pressure and reduced torque on valve stem.

CUP AND CONE TYPE PACKING

Chemiseal Type 810-W TEFLON Packing for both hand and mechanically operated valves. Cones deform inwardly to effect a seal at the spindle, while cups expand outwardly against stuffing box wall, making possible a tight seal at low gland pressure.



WEDGE TYPE PACKING

Chemiseal Type 810-WX Packing offers the unusually low gland load required for valves made of Haveg, Karbate, ceramics, etc. Rings provide space for thermal expansion. Also adaptable for spring loading wherever exceptionally low friction load is required.

PUMP PACKING

For general purpose or non-contaminating pump service throughout the processing industries, order Chemiseal Types 711-G, (graphite, impregnated) No. 711-M (impregnated with mica), and No. 711-0 (pure TEFLON).

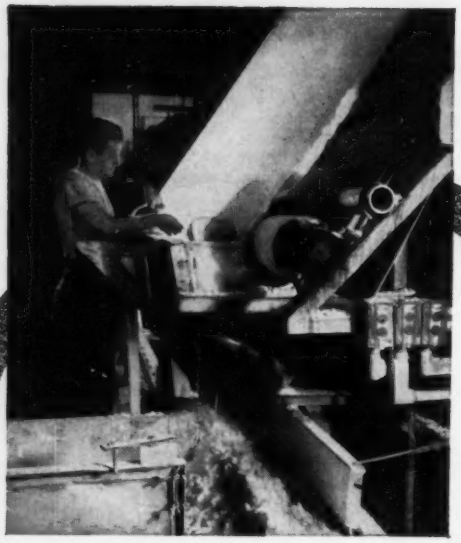
Write for Catalog No. TP-1053.

made of duPont TEFLON

UNITED STATES GASKET CO. Camden 1, New Jersey

FABRICATORS OF FLUOROCARBONS AND OTHER PLASTICS

Representatives in principal cities throughout the world



Continuous sheet of sticky, dewatered hydrogel, neatly lifted from filter drum at top right, is carried by strings to discharge roll, falls to conveyor.

YOU CAN PUT ALMOST ANY FILTER CAKE ON FEinc STRINGS

The FEinc String Discharge Filter . . . the original rotary vacuum string filter . . . easily handles thin soupy slimes, heavy sludges, coarse granules or fibres, sticky gels . . . almost any type of cake. The strings pick the cloth clean. The cloth does not smear and plug . . . you get more filtration per foot with FEinc. Blow-back is completely unnecessary, hence there's no wire winding. There's no scraping wear, hence cloths last two to five times longer. Cloth changing takes less time, too. The strings actually help. String life is excellent.

These are just a few of the reasons why, in a surprising number of cases, this FEinc is the most economical of all filters for the "easy" jobs as well as the tough ones.

The string filter is only one of many types of continuous filters now made by FEinc . . . backed by 35 years of experience . . . with proved ability to deliver tailor-made filters at no more than standard costs. Write or phone for details.



Ask for FREE technical bulletins

Filtration Engineers, Inc.

CUSTOM DESIGNERS AND MANUFACTURERS OF ALL TYPES OF CONTINUOUS FILTRATION EQUIPMENT

FEinc

155 ORATON STREET • NEWARK 4, N. J.

45

NAMES . . .

Division, Allied Chemical & Dye Corp. Mr. Brandon, appointed general manager in 1935, had been with Semet-Solvay for 38 years.

G. W. Van Cleve—Vice president and general manager of Allied Scientific Products Co., Culver City, Calif. Mr. Van Cleve will continue as sales manager of Stillman Rubber Co.

Robert S. Stevenson — Elected president of Allis-Chalmers Manufacturing Co. **Harold M. Schudt** is president of Canadian Allis-Chalmers Ltd.

Howard R. Huston—Retired from his position as vice president and director of American Cyanamid Co. Mr. Huston will serve the company as a consultant.

A. Ross Adams—Assistant to the vice president of research and development at American Viscose Corp.

M. A. Johnson—Research engineer for the Great Falls, Mont., department of Anaconda Copper Mining Co.

Raymond A. Erickson—Supervisor of the new engineering economics research department at Armour Research Foundation. For the past 1½ years, Mr. Erickson has been supervisor of the foundation's chemical engineering research section. **Arthur G. Metcalfe,** research metallurgist, has been promoted to senior metallurgist, highest professional position at the foundation.

Herbert H. Clarke, Jr.—Executive vice president of the Borden Co.'s chemical division.

C. A. Stokes—Elected to the board of directors of the Industrial Research Institute for a term of three years. Dr. Stokes is director of research and development for Godfrey L. Cabot, Inc., Boston, Mass.

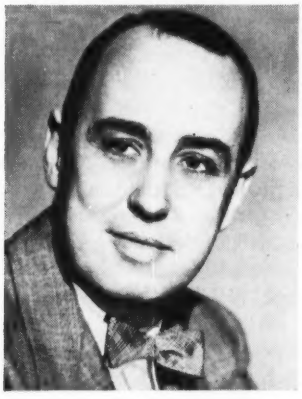
Norman B. King—Process engineer

at Carwin Co., North Haven, Conn. Mr. King was formerly associated with Stacey-Dresser Industries.

Paul H. Emmett—Will fill the new "Grace Chair of Chemistry," established by Davison Chemical Co., Division of W. R. Grace & Co., at Johns Hopkins University.

Ralph N. Lulek—Chemical and management consultant. Dr. Lulek was formerly vice president in charge of manufacturing and research of Grace Chemical Co.

E. Paul Lange — Succeeds **Brig. Gen. Stewart E. Reimel** (ret.) as secretary of Engineers Joint Council.



Robert D. Scott

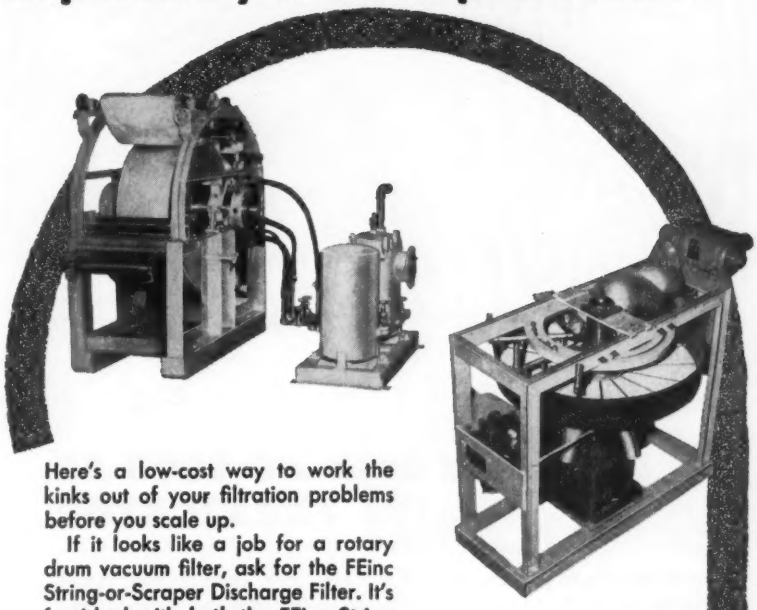
Robert D. Scott has been named vice president of manufacturing for B. F. Goodrich Chemicals Co. Since joining the company in 1935, he has served in various capacities including engineer at the Akron, O., rubber laboratories; technical superintendent at chemical plant No. 3 in Akron; general foreman and plant manager of the Niagara Falls, N. Y., Geon vinyl resin plant and manager of the Louisville, Ky., Geon plant. In 1951, Mr. Scott was named general manager of plants for the chemical company, a post which he held until his recent appointment.

Frank A. Drumb—Elected president of Canadian Western Lum-

NOW 2 FEinc

PILOT PLANT FILTERS

help reduce your development costs

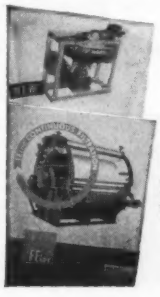


Here's a low-cost way to work the kinks out of your filtration problems before you scale up.

If it looks like a job for a rotary drum vacuum filter, ask for the FEinc String-or-Scraper Discharge Filter. It's furnished with *both* the FEinc String Discharge and the FEinc Scraper Discharge mechanisms. You can try first one, then the other. It also has the FEinc submergence washing and compression dewatering mechanisms. These can be operated separately or disconnected if desired. This all-purpose pilot plant filter is available to you on a unique rental-purchase plan, requires no capital investment. Ask for details.

If it's a relatively free-filtering job, such as a coarse crystalline or fibrous pulp, try the simpler FEinc Horizontal Filter first. Particularly good for counter-current or multiple-stage washing. Only 3 ft. dia., with amazingly high output.

Whatever your problem, if it's *continuous* filtration, talk to FEinc first. Our engineering service is backed by 35 years of experience, and by our well-known ability to deliver filters that are tailor-made to fit the job . . . at no more than standard costs.



Ask for Bulletin

Filtration Engineers, Inc.

CUSTOM DESIGNERS AND MANUFACTURERS OF ALL TYPES OF CONTINUOUS FILTRATION EQUIPMENT

FEinc

44 155 ORATON STREET • NEWARK 4, N. J.

Custom Built

STAINLESS STEEL EQUIPMENT....



...is ONLY AS GOOD AS ITS FABRICATOR

From the minute you decide on a made-to-order stainless steel vessel, you're in the hands of a fabricator. In fact the selection of your fabricator is generally one of your big problems.

It's more than a question of following blueprints. Stainless steel is a difficult alloy to work. It "acts up" during fabrication. In cutting, forming, welding and even in finishing, your fabricator must know how to guard the corrosion resistance and strength of the alloy. His plant must be specially equipped for working with stainless steel. The longer his experience, the more help he'll give you in building vessels that meet your requirements.

We work exclusively with stainless steel and alloys. Our plant is specially tooled to fabricate this metal. Our engineers and mechanics are particularly trained for the work. Why not consult us when you plan your next stainless steel vessel?

S. BLICKMAN, INC. • 607 GREGORY AVENUE • WEEHAWKEN, N. J.

S. BLICKMAN, INC.
Guards Alloys in Fabrication

SEND FOR THIS VALUABLE BOOK

A request on your letterhead will bring our guide, "What to Look For When You Specify Stainless Steel for Your Processing Equipment."

CORROSION RESISTANT PROCESSING EQUIPMENT

TANKS • KETTLES • STILLS • HEAT EXCHANGERS • AGITATORS • MIXERS • TOWERS • PIPING

NAMES . . .

ber Co., an affiliate of Crown Zellerbach Canada, Ltd., **Robert J. Filberg,** president of Canadian Western, has been elected chairman of its board of directors.

William A. Peterson—President of the American Oil Chemists' Society. Mr. Peterson is assistant director of the research and development department, Colgate-Palmolive Co.

Lewis C. Wallace—Appointed manager of process development, Crown Cork & Seal Co.

William F. Styler, Jr.—Vice president and treasurer, Deep Rock Oil Corp.

William J. Lightfoot—Chief staff engineer in Diamond Alkali Co.'s central engineering department. **Robert J. Koll** is plant manager of the company's Greens Bayou plant, Houston, Tex.

Charles A. Cary—Retired as a vice president and member of the executive committee of E. I. du Pont de Nemours & Co. He retains his position as a member of the Du Pont board of directors.

P. J. Byrne, Jr.—Deputy to Charles E. Paules, vice president of Esso Research and Engineering Co. **John W. Packie** is the new Esso Engineering manager, **Luther B. Martin** is associate manager.

Alan C. Tully—President of Ethyl Corp. of Canada Ltd., newly formed subsidiary of Ethyl Corp.

Charles E. Wilson—New chairman of the board, W. R. Grace & Co., succeeding **William Grace Holloway,** retired.

L. O. Crockett—Appointed general manager of Gulf Oil Corp.'s newly formed chemical department.

Bert W. Whitehurst—President of the recently formed Hawkridge Metals Corp., Boston, Mass. He

will continue as manager of the titanium division of Hawkridge Bros. Co., Boston, and also carry on his practice as consulting engineer.



Olaf A. Hougen

Prof. Hougen, professor of chemical engineering in the University of Wisconsin's College of Engineering, was awarded the first annual Benjamin Smith Reynolds Award of $1,000 for "excellence in teaching of future engineers" at the seventh annual Engineers' Day dinner held in Wisconsin's Memorial Union, May 6. Prof. Hougen has taught chemical engineering at the university for 34 years, and is known internationally for his teaching and scholarship in this field. He is the co-author of four basic volumes in chemical engineering and some 65 publications in his field during the last 25 years. In 1951 Prof. Hougen gave the Fulbright lectures in chemical engineering at Norway's large technological school at Trondheim.

Kenneth W. Robertson—Chief engineer of Central Soya Co., Inc., Fort Wayne, Ind.

Carl H. Mueller—Vice president in charge of engineering, Lincoln Engineering Co., St. Louis, Mo., manufacturer of lubricating equipment.

Harold M. Sonnichsen—Vice president of Permacel Tape Corp., New Brunswick, N. J.

John M. S. Hutchinson—Elected

All Process Temperatures Now Recorded on One Chart at Low Cost



FACTS ABOUT THE FIELDEN MULTI-POINT RECORDER

- Records on one chart as many as 6, 24, 48 or even 96 points of temperature, pressure, level, pH, conductivity, speed, etc.
- Can be provided with control function having a single point or individually controlled points.
- Provides easy readability with 6 different color traces in each segment of the chart.
- High-speed recording—5 seconds per point.

Many process plants are now finding that they can accurately record all process temperatures or other variables of the same kind on one Fielden MULTI-POINT Recorder at a new low in cost per point.

Results in numerous applications show that Fielden MULTI-POINT Recorder not only provides all the accuracy needed for most processes (±0.5%), but its high speed insures quick warning of any upsets. In addition, the instrument's simplified design enables plant personnel to handle any maintenance. These design features provide big savings in initial and operating costs.

Send the coupon today, and learn how *Fielden Simplified Instrumentation* can solve your problems too . . . dependably *and* economically.

Robertshaw-Fulton CONTROLS COMPANY

FIELDEN INSTRUMENT DIVISION
Dept. H, 2920 N. 4th St., Philadelphia 33, Pa.

Please send me bulletins describing:
☐ FIELDEN MULTI-POINT Recorder-Controller
☐ TEKTOLOG Recorder-Controller
☐ TEKTOR Level Limit Control
☐ NULL-BALANCE Recorder-Controller
☐ TELSTOR Continuous Level Indicator

NAME _____ TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE _____ STATE _____



Pangborn answers the



"Call from Philip Morris"

Collects 5,000 lbs. of tobacco particles daily to be sold for salvage.

At the stemmery plant of Philip Morris and Co., Ltd., Richmond, Va., the tobacco used in Philip Morris products is processed prior to manufacture into cigarettes. To keep the working area immaculate and maintain the excellent operating conditions, Philip Morris calls upon four Pangborn Dust Collectors for efficient removal of any minute tobacco particles released in this processing. Every day, Pangborn Dust Control collects 5,000 lbs. of particles which are sold as fertilizer ingredient. In addition, Pangborn minimizes plant housekeeping problems.



Pangborn can solve *your* dust problem. Pangborn engineers will be glad to show you how Pangborn Dry or Wet Dust Collectors can save you time, trouble and money.

See how Pangborn benefits varied industries. Write for free copy of "Out of the Realm of Dust." Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn
CONTROLS DUST

NAMES . . .

vice president and assistant to the president of Perkin-Elmer Corp., manufacturer of scientific instruments for chemical industry and research.

John R. Connolly—Manager of the newly created fluid agitator division, Philadelphia Gear Works, Inc.



Frank J. Smith

Frank J. Smith, who has been manager of the petrochemical division of American Oil Co., has been elected vice president and general sales manager, a director and member of the executive commitee of the newly formed subsidiary, Pan American Chemicals Corp. He joined the parent company as assistant director of research at Texas City in 1942, then went east to head the chemicals division. Mr. Smith will continue to make his headquarters in New York City.

Nick P. Peet—Senior technical specialist in technical service at Humble Oil & Refining Co.'s Baytown, Tex., refinery.

Andrew H. Sweet—Director of commercial development for Overland Oil, Inc., Denver, Colo. Mr. Sweet was formerly engineer in charge of the Denver field office of the U. S. Bureau of Mines.

Norman L. Deuble—Manager of the newly created metallurgical development division of Climax Molybdenum Co. **Charles H. Kline** has been named manager

of the company's newly created chemical development division.

Charles M. Hickey, Sam S. Emison and Jennings C. Crowder—Vice presidents of Consolidated Chemical Industries Inc.

OBITUARIES

Robert D. Pike, prominent consulting chemical engineer, died April 13 at the age of 70. Since 1917 he had been retained as a consultant in various chemical fields including the manufacture of magnesia, magnesite, cement, phosphorus, potash, soda ash and electrolytic iron. At the time of his death, Mr. Pike was actively promoting his direct process for the manufacture of steel through the reduction of iron ore with natural gas.

Frank J. Stockman, senior vice president of Winthrop-Stearns Inc., pharmaceutical manufacturer, died suddenly on April 17. He was 68 years old.

Marvin Duff Smith, 45, internationally known chemical engineer and southern division general manager of Foster Wheeler Corp., died April 18 in Houston, Tex.

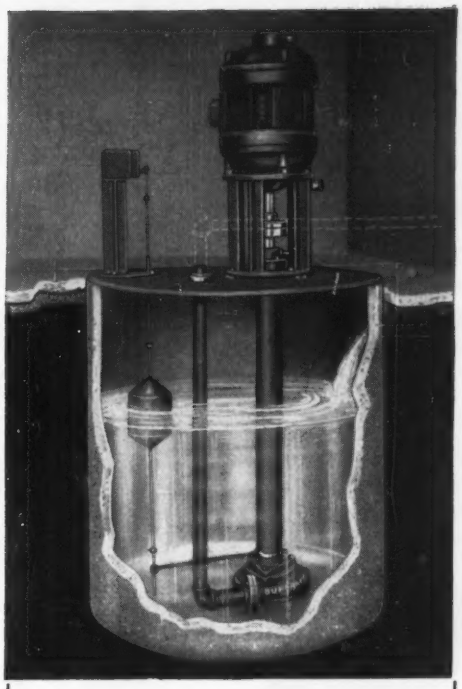
William Paul Stoll, 75, died April 19 in California. Until his retirement in 1947, he was West Coast manager, electrochemicals division, E. I. du Pont de Nemours & Co.

Hal Pond Eastman, 70, retired vice president and director of American Cyanamid Co., died May 4 in Pasadena, Calif., following a prolonged illness.

J. Paul Smith, 64, president of Visking Corp., died suddenly on May 4 in Chicago, Ill.

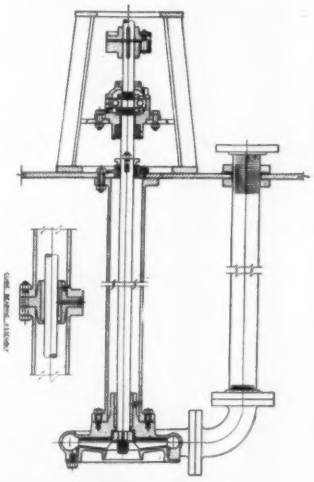
Carle M. Bigelow, 65, consultant and former assistant to the general manager of the fine chemicals division, American Cyanamid Co., died May 10 in Somerville, N. J.

3 ADVANTAGES IN THE SUMP PUMP



"Buffalo" SUMP PUMP

1. EASY INSTALLATION "Buffalo" Sump Pumps are shipped as complete units ready to place in the sump or tank. There is nothing to assemble and no shaft alignment problem.



2. ALWAYS IN PRIME, since there is no suction lift.

3. SIMPLIFIED MAINTENANCE Submerged operation eliminates need for suction seals, while the shaft is in permanent alignment. The shafts of "Buffalo" Sump Pumps are entirely enclosed, with ball bearing thrust at the top—and long, water-lubricated bronze sleeve bearing at the pump end.

FOR HOT LIQUIDS, ACIDS, or where fumes are present "Buffalo" Sump Pumps are available with a stuffing box in the cover.

WRITE FOR BULLETIN 963 and see the *Built-in Quality that provides trouble-free satisfaction and long life*—the "Q" factor that you get in every "Buffalo" Pump.

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

501 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

DURASPUN

20-FOOT FURNACE ROLLS
Centrifugally Cast

. . . of Duraloy HH Alloy, one of the most widely used high chrome, medium nickel alloys.

Two items concerning these furnace rolls may be of particular interest:

a—the size: 20 feet long—14" OD, ¾" wall thickness

b—welding operations by which reducing cones and shafts (both statically cast of the same alloy) were welded to the centrifugally cast rolls

These two items will serve to emphasize two phases of our service: (1) the large size centrifugally cast tubes we are able to produce and (2) our machining and finishing facilities, including welding.

Our new 16-page general Bulletin — 3354-G — gives complete details. Would you like a copy? When writing or calling would you mind telling us the general nature of your high alloy casting requirements? Better yet, if you have specific requirements on which we could help, let us have the details.

THE DURALOY COMPANY
OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.
CHICAGO OFFICE: 332 South Michigan Avenue

THIS MONTH'S

Letters:

Complaint Against Graduates

Sir:

My experience with graduates-to-be is not entirely pleasant. On several occasions a student hired before graduation would renege a few weeks later and switch allegiance to another employer.

With so many jobs offered, the student is like a small boy in a candy shop. He puts down the jelly beans he had just bought because a gaudy peppermint stick suddenly strikes his fancy. Then, there is also the odd bit of piracy practiced by sharp employment scouts.

College authorities could inculcate the elements of ethics and a sense of responsibility, for the present situation will not last. The shoe may then be on the other foot.

NAME WITHHELD

Research & Development Dept.
Montreal, Quebec

► *Unfortunately, this practice of "reneging" seems to be fairly common today. Too many young graduates evidently don't realize the seriousness of their responsibilities.*

For an equally common complaint against the companies themselves, see the following letter. By request, and for understandable reason, the authors remain anonymous.—ED.

Complaint Against Companies

Sir:

I have written to several companies recently advertising for young engineers. Thus far, not one has had the propriety or intelligence to so much as acknowledge my application.

Apparently there are so many unemployed engineers to choose from that they do not feel compelled to adhere to the common amenities that even cave-men might use. . . .

NAME WITHHELD

Ames, Iowa

► *This is a common complaint against companies advertising for engineers, especially those placing "blind" ads.*

Pro & Con

One graduate recently told us he had written 40 letters to chemical companies in response to ads; 23 of the companies never bothered to acknowledge in any way.

*A group of young engineers in Rhode Island, discussing the question of professional recognition and employer-employee relations, estimated that 60% of the firms placing "Engineers Wanted" ads do not acknowledge the applications. This is public relations at its lowest ebb.—*ED.

Clip With Ease

Sir:

I read the Pro & Con section in your March issue and noted especially the letter "More on Clippability."

Your readers may be interested to know of the existence of a razor blade holder, a neat little gadget that makes it a pleasure to clip pages out of a magazine. I enclose one such blade holder. . . .

THOMAS G. PALSULICH

Fresh Meadows, N. Y.

▶ *The "Ambi" utility razor blade holder sent by Reader Palsulich is available at most large "dime" stores. It is indeed a handy gadget for clipping magazine pages.—*ED.

Pricing Economics Questioned

Sir:

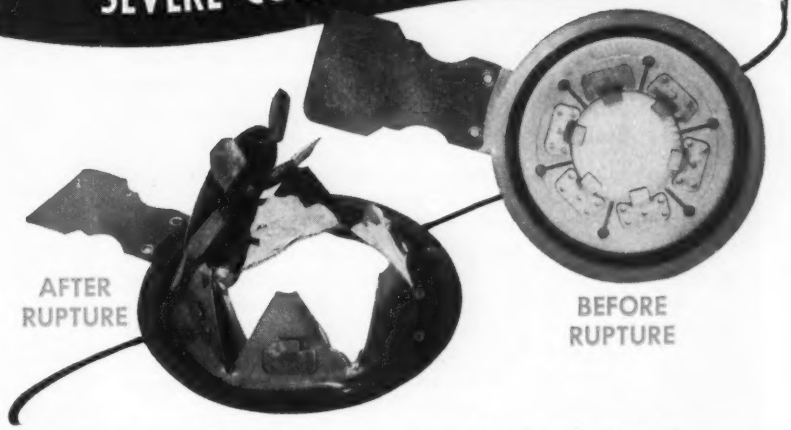
I take issue with Mr. Schuman's article "Economics of Pricing" in your March issue. He seems ready to throw out the so-called "classical theory" of economics. This has been advocated before, but usually the exceptions and contradictions prove to be merely special cases.

The article was very informative and valuable from the standpoint of the correlation presented. My disapproval extends only to his disavowal of present economy theory.

The correlation of price and production rate is nothing more than the supply schedule of classical economics which shows the relationship between prices and the amounts producers are willing to produce. The curve is unusual in

HERE'S THE *New* RUPTURE DISC FOR BS&B SAFETY HEADS...

...ESPECIALLY DESIGNED FOR USE IN LOW PRESSURE APPLICATIONS UNDER SEVERE CORROSIVE CONDITIONS!



For many years the problem of producing a low pressure rupture disc that could withstand prolonged exposure to severe corrosive conditions was a perplexing one. Yet, it was a problem that *had* to be solved, particularly for the Process Industries.

Therefore, it was only natural that BS&B — originator of the Safety Head — should come up with the right answer in the form of a flat type rupture disc whose bursting pressure is controlled by a top metal section, isolated from the corrosive contents of the protected vessel by a sealing membrane of Teflon or Kel-F.

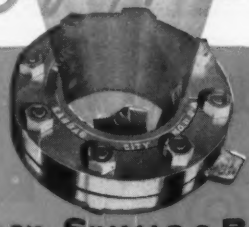
If back pressure is not anticipated, the bottom metal section of the disc is cut open to full relieving capacity (Model 1A). However, if a vacuum support is needed, the bottom metal section is constructed similar to the top section to serve as a vacuum support (Model 1B). Top and bottom sections are spot welded together to give a single compact unit.

Disc Models 1A and 1B are constructed of corrosion-resistant metals such as Inconel, stainless steel, nickel, Hastelloy B and Monel. Either model is available in 2", 3", 4", 6", 8" and 10" sizes. Pressure ratings are from 8 to 100 lbs. Close design tolerances are an inherent feature of this type disc.

If you have a pressure relief problem which you have not been able to solve satisfactorily with the regular pre-bulged type of disc or other types of relief devices, try the new BS&B Model 1A or 1B disc. It fits any standard size BS&B Safety Head flanges you may now have in service. Also available in a complete assembly consisting of inlet and outlet flanges, rupture disc, studs and nuts.

Your BS&B Man will be glad to give you details . . or you may write for descriptive literature and prices.

BS&B Safety Heads



THE "CIRCUIT-BREAKER" OF Pressured Systems

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-N7
7500 East 12th Street, Kansas City 26, Mo.

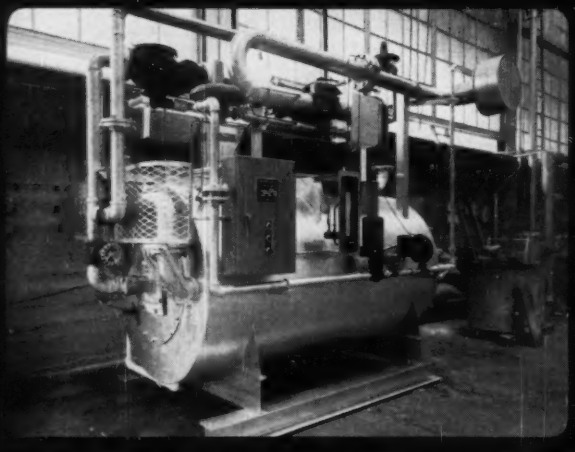
EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

"We Should Have Had This Years Ago," Said a U.S. Industrial Chemicals' Executive of a Gas Atmospheres' CO_2 Generator

Many chemical plants have a by-product supply of carbon dioxide gas which they often attempt to salvage and harness for blanketing and purging use within their own plant. However, relying on such a source is risky at best. It is dependent upon regular production of the product from which the gas is derived and subject to uncontrolled variances of gas purity and compression.

The Gas Atmospheres' compact, high efficiency, self-contained gas generators, that will produce any amount of atmosphere directly from city gas or oil, in the pressure and purity desired, best relieves this undesirable dependency. Wherever users of carbon dioxide, nitrogen or inert gas have heard the story, compared prices and weighed the advantages of this independent gas supply against any other source, Gas Atmospheres has been able to do business.

For example, after comparing costs and production figures, one executive of the U. S. Industrial Chemicals plant in New Orleans said of their new Gas Atmospheres' generator, "We should have had this years ago." Perhaps you should have, too. Why not find out? Just drop a line to Gas Atmospheres, Inc., and let us know the gas consumption you require and we'll work out a cost chart that will show you how this amazing generator will pay for itself in a few months.



gas Atmospheres, inc

equipment for producing industrial gases

20811 WEST LAKE ROAD CLEVELAND 16, OHIO

PRO & CON . . .

that it has a negative slope where most commodities have a supply curve with a positive slope. This is probably due to the fact the chemical industry is a "growth industry" and is mostly in the region of decreasing costs with expanded production.

Throughout the discussion he uses actual prices from the supply schedules for 1940 and 1948 without taking into account the demand schedules which determine these prices. Each one of the points on the correlation represents an equilibrium point between supply and demand. The information which is lacking is the corresponding demand curve for the entire broad class of chemicals.

A possible solution which would explain the remarkable correlation observed in the article would be to make the assumption that the overall demand curve for these chemicals is roughly superimposed over the supply curve. This is not a rash assumption since the demand curve normally has a negative slope.

To look at it another way, Mr. Schuman attempts to disprove the effect of demand on price determination by ignoring it. To disprove it, he would have to show demand schedules and indicate their inability to explain the actual market conditions.

Although I share Mr. Schuman's pride in the progress and economic prowess of the chemical industry, I cannot condone his statement that "high demand produces high prices, as prescribed by classical economic theory, only when the economy is stagnant and unprogressive." I consider this unfair and uncomplimentary to the majority of industry where this condition is existent. It can (and probably will) happen to the chemical industry some day when the quantity demanded exceeds the ability to produce without raising costs.

KENNETH E. KLOTZ
Chemical Engineer
Reilly Tar & Chemical Corp.
Indianapolis, Ind.

►*For Author Schuman's answer, see the letter that follows.*—ED.

Pricing Economics Answered

Sir:

The correlation of price and production rate is not a supply schedule curve. A supply schedule curve always shows less material in the market as price goes down. The correlation shows the opposite. The only way to explain the correlation is that high production rates result in low prices—an explanation that shouldn't be hard for anybody to take.

But what causes high production rates? It is the desire of the customer to buy. If you call it "demand," it follows that high "demand" results in low prices.

The instantaneous situation that is the basis of classical economic price theory (where price is the result of an equilibrium between supply and "demand" schedule curves) is a pretty picture. Maybe it applies to the price of rare stamps or Dufy originals. But you can't prove it because supply and demand schedule curves simply don't exist outside of textbooks.

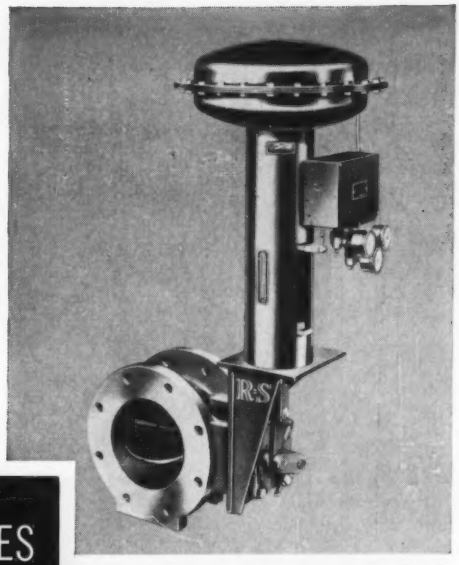
In the case of synthetic chemicals, the classical theory does not apply except where supply does not react to "demand." In this case, price will rise.

My calling this kind of thing stagnant wasn't very original because Henry Ford said the same thing about fifty years ago. Ford built an automotive industry based on a policy of high production-low unit cost-low price; the tremendous advances in the chemical industry seem to be due to the same factors operating.

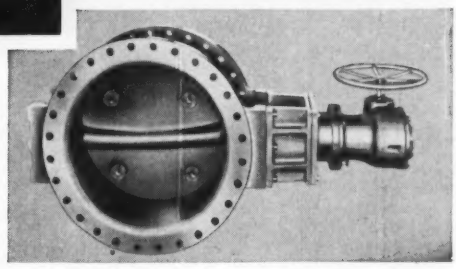
Apologies, of course, to the producers who can't produce more because of difficulties with the supply of raw materials; in their case, static is certainly a better word than "stagnant and unprogressive."

Mr. Klotz's last sentence poses the sixty-four dollar question: How big can you get and still reduce unit costs? My guess is as big as all get-out! Anybody got any data?

S. C. Schuman
Associate Director of Research
Hydrocarbon Research, Inc.
Trenton, N. J.



R-S
BUTTERFLY VALVES



R-S VALVES ASSURE ACCURACY, SPEED AND ECONOMY

Automatic or manual—whichever you choose—the S. Morgan Smith R-S Valve line meets these three challenges to valve performance.

UNIFORM CONTROL IN ALL POSITIONS . . .
R-S Valves give consistent control of flow through all positions in its normal regulating range. The disc simulates a straight line, semi-log quality.

REGULATION AND CLOSURE ARE QUICK . . .
R-S manual valves are actuated by a lever, chain lever, handwheel or chain handwheel. Power actuation can be provided if desired.

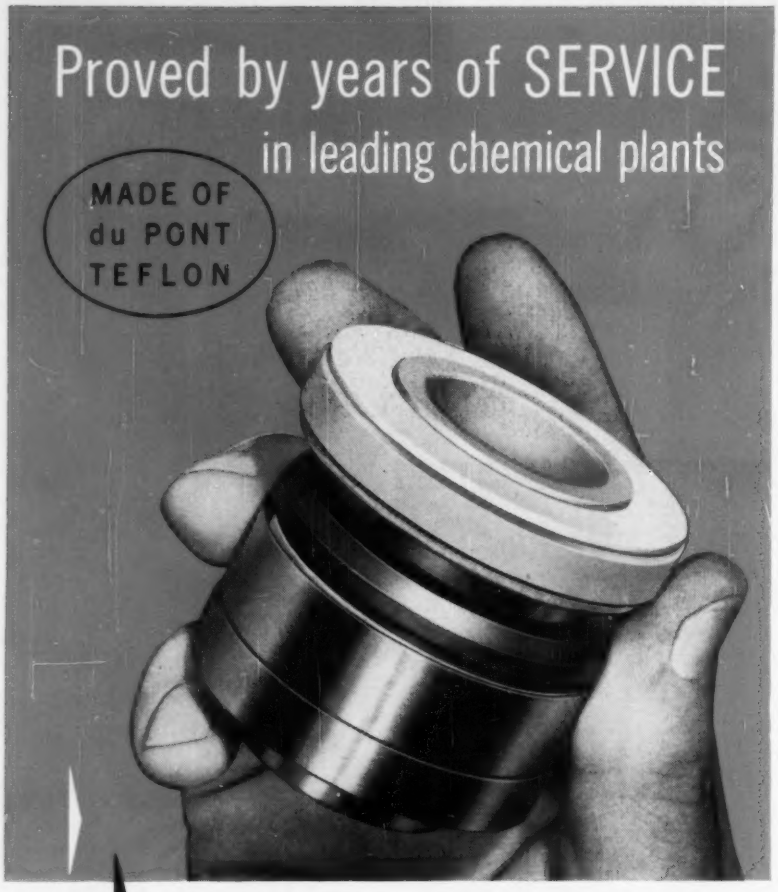
MINIMUM PRESSURE DROP SAVES POWER . . .
The bevelled disc of the R-S Valve seats solidly with a metal-to-metal seat. Accurate machining and a 9° to 12½° angle of closing insure minimum clearance for minimum leakage. Drip-tight or bubble-tight closure can be obtained with the positive action of a rubber seat valve.

Over 75 years experience in hydraulic design and engineering stands behind valves. For further information about butterfly, cone or ball valves for use in the process fields, see your instrument maker or write to S. Morgan Smith Company, York, Pennsylvania.

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES
HYDRODYNAMICS
ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

S. MORGAN SMITH CO.

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO



CHEMISEAL SHAFT SEALS

Customers report unsurpassed performance and much longer life under a wide variety of chemical service conditions, with Chemiseal Mechanical Seals.

A superior material—duPont TEFLON, and a one-piece balanced bellows design are responsible.

Chemiseals rotate with shaft. Only bearing surface is between precision ground stationary and rotating faces—the latter being an integral part of the TEFLON bellows unit.

Advantages include: Applicable to all chemical requirements, including clear, abrasive and tarry materials. Seal drop-tight and stay tight. Low friction load on shaft. No scoring of shafts—shafts already scored can be satisfactorily sealed. Pressures at the seal to 100 psi at 75° C or 75 psi at 100° C. Standard sizes ⅜" to 2⅛". Other sizes on special order. Over-all length 2½".

Write for Bulletin No. MS-954.

UNITED STATES GASKET CO., Camden 1, N. J.

FABRICATORS OF FLUOROCARBONS AND OTHER PLASTICS

Representatives in principal cities throughout the world

THIS MONTH'S

Technical

Thorough and Readable

WATER CONDITIONING FOR INDUSTRY. By Sheppard T. Powell. McGraw-Hill Book Co., New York. 548 pages. $9.

Reviewed by Eric Pick

There are few long-established and basic industries which have gone through more radical changes in recent years than the water treatment industry, in improving old methods and equipment as well as in developing new ones. And I can think of no one better qualified to write objectively and impartially about the present state of this art than Sheppard T. Powell, who has been a consulting engineer specializing in water treatment for perhaps more years than he cares to remember, and who, consequently, has kept himself well informed of the changing demands for purified water and the ways in which equipment manufacturers met such demands.

Every industry needs water but few are satisfied with the condition in which it is supplied by nature or the local water company. The requirements for the greatest purity attainable with practical treatment methods come from high pressure boiler plants, and so this book deals thoroughly with all phases of treating water for steam generation, including chapters on evaporators, deaeration (the author is inventor of a patented vacuum degasifier), steam contamination, corrosion problems, caustic embrittlement, chemical cleaning of power plant equipment, etc.

Many modern chemical processes are fully or nearly as stringent in their demands for water of the greatest possible purity as are high pressure boiler plants and, therefore, use the same treatment methods. This is true in the manufacture of some textiles, photographic materials, pharmaceuticals and mirrors, just to name a few.

Bookshelf

L. B. Pope

It should not be inferred from the foregoing that this is not a book for those who are less exacting in their requirements for pure water. Adequate space is given to settling, coagulation, filtration, cold and hot process treatment.

The longest chapter, almost 50 pages, is devoted to ion exchange. It traces the history of this special field from the very beginning and describes in considerable detail materials, methods and equipment available for treatment ranging from plain zeolite softening to complete demineralization with silica removal by strongly basic anion exchange resins which became a reality just a few years ago.

At the end of each chapter is a bibliography of references which will be most useful to those who want more detailed information than can be included in such a book. The last chapter deals with analytical procedures. There is also an appendix with tables and graphs and, of course, an index.

The book is thorough, up-to-date and quite readable. It should be in the library of every boiler plant operator and engineer concerned with water treatment, especially those who have not had an opportunity to keep up with recent developments in this field.

No Loss of Reputation

PROTECTIVE COATINGS FOR METALS. By R. M. Burns and W. W. Bradley. Reinhold Publishing Corp., New York. 642 pages. $12.

Reviewed by C. L. Mantell

This is the second edition of Monograph 79, "Protective Coatings for Metals" by Burns and Schuh, published in 1939, which in turn was really a revision with new authors of Monograph 40 of 1928, entitled "Protective Metallic Coatings" by Henry Rawdon. With some modifications the present edition follows the major portions



Un-alike as peas in a pod . .

Peas in a pod differ in ways, discernible only through close scrutiny . . . and the same can be said about most filtration equipment, both in performance and appearance.

However . . .

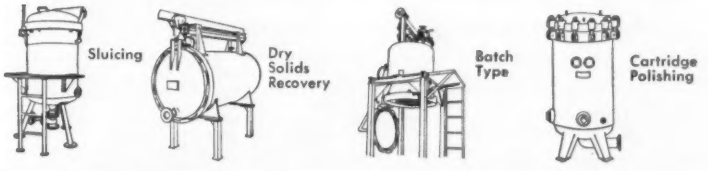
There is filtration equipment that is entirely different . . . PROCESS FILTERS. These filters have features, functionally unique, to produce efficient filtration at low cost. Just a glance at a Process Filter and you immediately associate its features with filtration efficiency, low operating cost and one man operation.

For Instance . . .



Look at this Model V Process Filter . . . The cover has no bolts, just a handle that releases the cover in a few, quick motions to save 15 to 20 minutes on every opening, permitting frequent inspection to insure maximum filter performance. The SPEED SLUICE (inset) . . . in combination with the RAPID OPENING COVER gives the operator positive sluicing control. This arrangement allows the operator to watch the cake discharge, minimizing the amount of sluicing liquid used. As a result, reprocessing of slurries are more economical because of higher concentrations with attendant savings in time and power. There are no connections to make or break to open the cover, and complete servicing of the header is only a matter of lifting out the attachment. This sluicing device is simple, yet as efficient as any mechanical method.

These are only a few of the features you'll find in the complete line of Process Filters . . . some particularly suited to your process . . . ALL designed to give you a better product at lower cost to keep you ahead of competition. You'll be interested in what Process Filters' engineers have for you . . . It will pay you big dividends to find out.



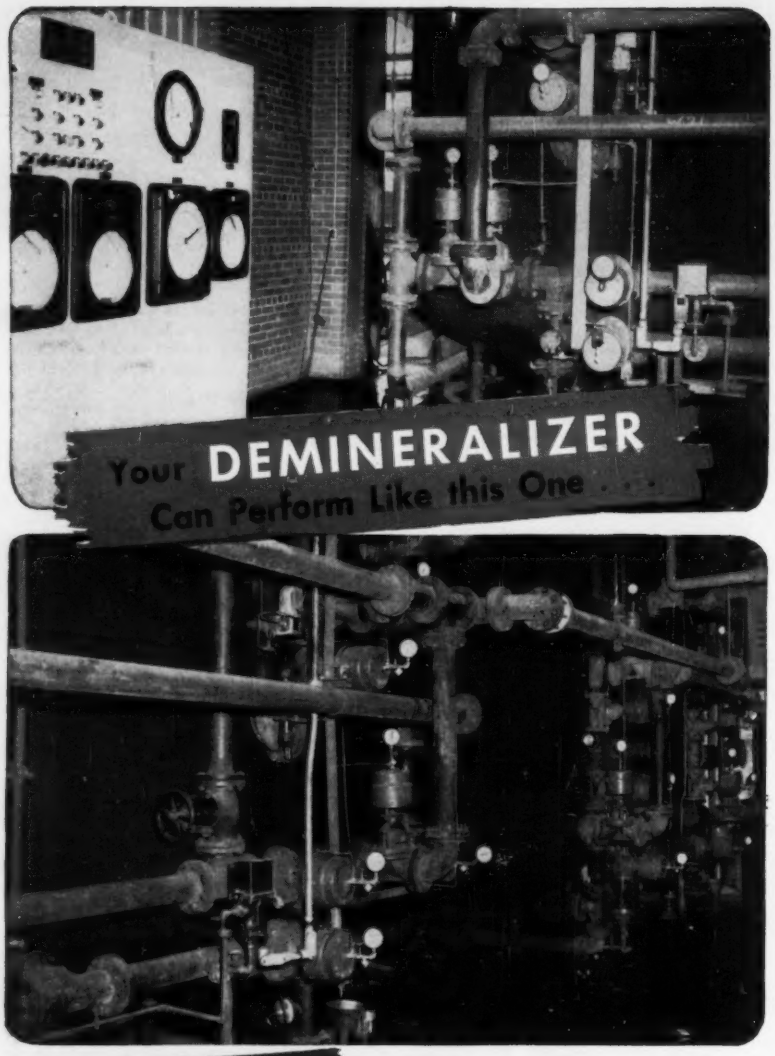
Process Filters, Inc. engineers and builds many types of filtration equipment to meet your particular requirements. For further information, mail this coupon.

PROCESS FILTERS, Inc.
1807 Elmwood Avenue, Buffalo 7, N. Y.

A subsidiary of Bowser, Inc. BOWSER

Gentlemen:
Please send me information on the following:
☐ Dry Solids Recovery Filters
☐ Batch Type Filters
☐ Sluicing Filters
☐ Cartridge Polishing Filters

Name .....
Title .....
Company .....
Address .....
City .....Zone....State.....



Nalcite HIGH CAPACITY HIGH TEMPERATURE ION EXCHANGE RESINS

500 gallons per minute of clarified Missouri River water are completely deionized for 100% make-up to a 1250 psig boiler by this Nalcite-charged unit at a large Midwestern utility. Whether your water conditioning problem is large or small, Nalcite HCR cation exchange resin, together with either Nalcite SAR or SBR anion exchanger gives you performance that means longer on-line operation, with removal of both strong and weak acids including silica.

Full information on Nalcite Ion Exchange Materials is yours for the asking. Write today.

*Reg. Trademark of the Dow Chemical Company

NATIONAL ALUMINATE CORPORATION
6236 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Nalco PRODUCTS • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology*

of the outline of the earlier work, but with approximately 60% increase in volume.

The first section on principles of corrosion and corrosion control has been enlarged and brought up to date. There is a new chapter on surface preparation for coatings inserted before the discussion of the types of metallic coatings and methods of application. Sprayed metal coatings have increased to sufficient importance that they now warrant a separate chapter. Zinc coating by whatever method treated are all coordinated rather than being subdivided into hot-dipping and electroplating.

As before in the earlier edition this is followed by sections on cadmium, tin, nickel and chromium, and then sections under which copper, lead, aluminum and miscellaneous metals are discussed together. The new edition also has a section on coating of rare and noble metals and methods of testing these metallic coatings. This section, requiring 40 pages in the old edition, now consumes 63 pages, indicating the enlarged scope of this activity.

In the previous edition 93 pages were devoted to the composition of paints, mechanism of film formation, the durability and evaluation of paints and paint practice.

In the new edition there is marked enlargement, the chapters being labeled: "Organic Coatings —Chemistry and Composition"; "Performance and Evaluation"; "Application and Use of Protective Organic Coatings." The discussion is now nearly 200 pages, replete with performance characteristics, evaluation, and critical discussion. In the 1939 edition the concluding chapter was "Miscellaneous Coatings." In the new edition there are three chapters: one on "Chemical Conversion and Anodized Coatings"; another on "Special-Purpose Coatings"; and the concluding one dealing with "Corrosion Inhibitors."

Rawdon, in 1928, was a classic. Burns and Schuh, in 1939, continued the high standards. Burns and Bradley, in 1955, cause no loss of reputation in enlargement, in up-to-

dateness, conciseness, and critical viewpoint.

The volume is highly recommended for the many workers in the field of corrosion, coating evaluation and performance. "Protective Coatings for Metals" by Burns and Bradley will join the other "solid" books on the engineer's library shelf and continue to be a reliable reference source. Query—why did the second edition of Monograph 79 become Monograph 129? Is there value in large numbers?

Electrochemistry

ELEKTROLYTISCHE ABSCHEIDUNG UND ELEKTRO-KRISTALLISATION VON METALLEN. By Hellmuth Fischer. Published by Springer Verlag, Berlin, 652 pages.

Reviewed by M. Wulfinghoff

This volume is number 12 in a series of monographs on theoretical and applied metallurgy. It is a scholarly presentation of a complex subject.

It starts out with the definitions and fundamental tenets of electrochemistry, discusses double layers at phase boundaries, diffusion films on cathodes, the mechanism of cathodic separation of metals from solutions of simple salts, effects of inhibitors, and distribution efffects. The following chapter deals with the kinetics of crystallization, characteristic configurations of polycrystalline deposits, and non-metallic inclusions.

Properties of cathodic metallic deposits, as smoothness, hardness, stress conditions, adherence, electric resistivity, corrosion resistance, and structural properties are discussed in detail. Finally, basic requirements of electrodeposition are outlined for specific metals.

The book is the result of a thorough investigation of the state of present researches in the field, and consequently there is a wealth of bibliographical references. It should, therefore, be of distinct value to both theoretical and practical metallurgists.

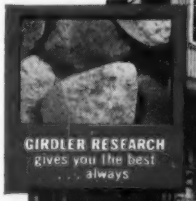
HOW YOU BENEFIT WITH GIRDLER CATALYSTS











Increases ammonia output 40% with

GIRDLER G-29 CATALYST

at Mississippi Chemical Co., Yazoo City, Miss.

APPLICATION: Promoting reaction of steam, air and natural gas in reforming furnaces to produce ammonia synthesis gas.

TECHNICAL SERVICE of Girdler demonstrated that a switch to its newly developed G-29 would result in an appreciable increase in the ammonia production.

RESULTS: Greater activity of G-29 enables customer to increase ammonia production about 40% when required. This is accomplished with no appreciable increase of fuel consumption per unit of ammonia produced.

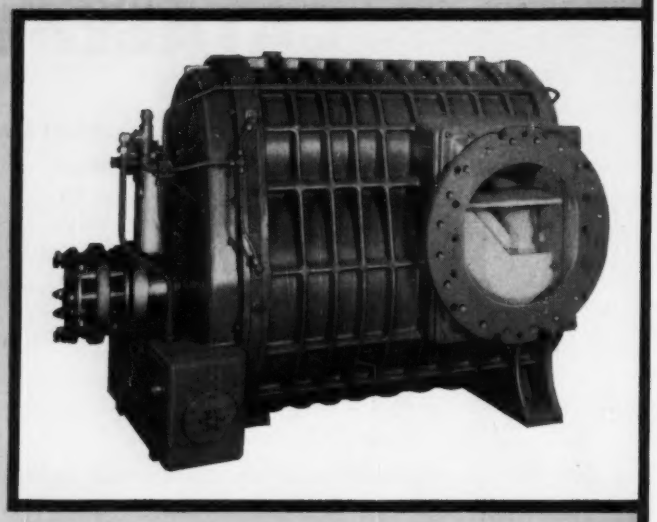
Find out how Girdler Catalyst Technical Service can help *you!* Write for Bulletin G-260.

The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

GAS PROCESSES DIVISION: New York, San Francisco
VOTATOR DIVISION: New York, Atlanta, Chicago, San Francisco
In Canada: Girdler Corporation of Canada Limited, Toronto

GET GREATER CAPACITIES



with

Standardaire® Blowers

Standardaire Blowers offer a greater capacity per pound of blower and less power consumption than other blowers of equal weight and size.

The increased outputs are only made possible by Standardaire's rugged, simple, compact construction, and its exclusive cycloidal, screw type rotors. Facts and figures you're after? Here are tested ratings for the Standardaire 175X32 Blower which measures 6 feet long and weighs approximately 8,000 lbs.

Operating at 1200 RPM, consuming 530 BHP the Standardaire 175X32 delivers 9,000 CFM at 12 PSIG. With a 625 HP input it delivers 8,870 CFM at 15 PSIG, and 8,670 CFM at 20 PSIG with 765 BHP input.

There's a Standardaire Blower designed to meet your low, medium or high capacity requirements. Get all the facts today, write . . .

READ STANDARD
CORPORATION

BLOWER-STOKER DIVISION
370 Lexington Avenue • New York 17, New York

THIS MONTH'S

Recent Books

Consultants

Classified and cross indexed, this directory will quickly locate a specialist consultant ready and able to tackle your problems. 134 pages.

"Consulting Services." 15th edition. Association of Consulting Chemists & Chemical Engineers, 50 East 41 St., New York 17, N. Y. $1.

Deafness

This legal survey was prepared to fill a need for reference material on existing laws providing compensation for impairment of hearing.

"Occupational Impairment of Hearing." By T. C. Waters. Industrial Hygiene Foundation of America, 4400 Fifth Ave., Pittsburgh 13, Pa. $1.

Asphalt

A report of steps taken in developing an effective wetting and bonding agent for asphalt. 14 pages.

"The Function and Chemistry of Asphalt Additives." By C. F. Huber & P. F. Thompson. Carlisle Chemical Works, Reading, Ohio.

Fluid Flow

Tables of friction loss for water in various pipe sizes and materials, resistance coefficients for valves and fittings. Charts of factors and data permit calculation of friction loss for any fluid in any size or shape of conduit. A handbook on pipe friction. 87 pages.

"Pipe Friction Manual." The Hydraulic Institute, 122 East 42 St., New York 17, N. Y. $1.75.

Chemical Producers

The number of western chemical producers has increased some 43 percent in the last six years. More than 475 chemical products are now being manufactured by 350 companies in 450 western plants. These facts emerge from a new directory now available which updates the directory of western

& Pamphlets

chemical producers published by *Chemical Engineering* in 1948. The directory lists specific chemical products and plant locations of prime producers of chemicals in the West. 100 pages.

"Directory of Western Chemical Producers." Stanford Research Institute, Stanford, Calif. $5.

Facts

The chemical industry, through its spokesman the Manufacturing Chemists' Association, presents itself in this book of facts. It concerns origins, operations, accomplishments and goals. Its three sections cover growth of the chemical industry, how the industry operates and chemicals in everyday life. 148 pages.

"The Chemical Industry." Second edition. Manufacturing Chemists' Association, 1625 Eye St., Washington 6, D. C. $1.

Facts From Europe

Sixteen O.E.E.C. countries participated in this survey which reports on the over-all market situation in Europe. General trends in the chemical industries of the various countries as well as trends in various representative sectors of the industry are also covered. General comments and additional data on imports and exports are included to supplement and amplify the discussions. 153 pages.

"The Chemical Industry in Europe." Organization for European Economic Co-operation, 2002 P St. N.W., Washington 6, D. C.

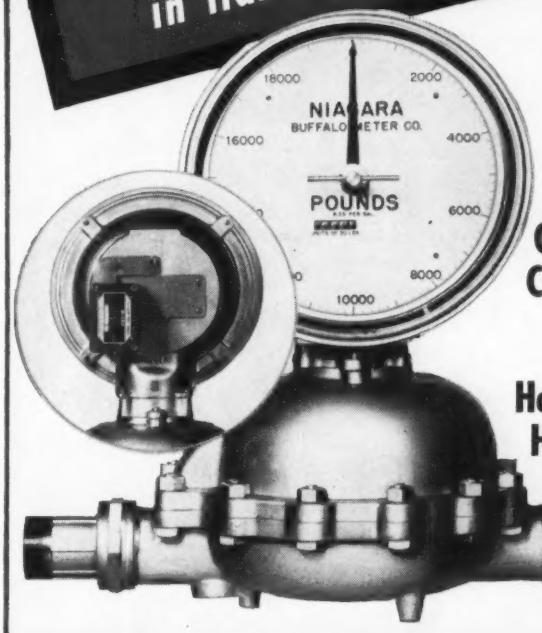
Matter

An exposition of the structure of the atom, nuclear energy, the nature of radiation and the fundamental constituents of matter. 501 pages.

"An Outline of Atomic Physics." Third edition. By O. H. Blackwood, T. H. Asgood & A. E. Ruark. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. $7.50.

NOW-Explosion Proof!
A New NIAGARA
Electricontact Meter

for Automatically Measuring and Controlling Liquids in Hazardous Atmospheres



Corrosive Chemicals
•
Oils and Solvents
•
Cold Water and Cold Water Base Liquids
•
Heated Water and Hot Water Base Liquids

For CHEMICAL PROCESSING PLANTS

Shuts solenoid valve or stops pump motor after preset gallonage has flowed through the meter. Opens or closes circuit to actuate any electrical controls. Provides automatic shut-off for batch measurements. Insures accuracy. Saves time. Increases production without increasing man-power requirements. Wide range of sizes and capacities of both Meters and Electricontact Registers.

Design incorporates Model EX-AR Microswitch which carries Underwriter's Laboratories listing for use in hazardous atmospheres, Class 1, Group C and D and Class 2, Group F and G. Electricontact register has new improved heavy duty construction. Used on 110 to 550 V. a.c.

Brings automation to liquid volume measurement and control even in hazardous atmospheres.

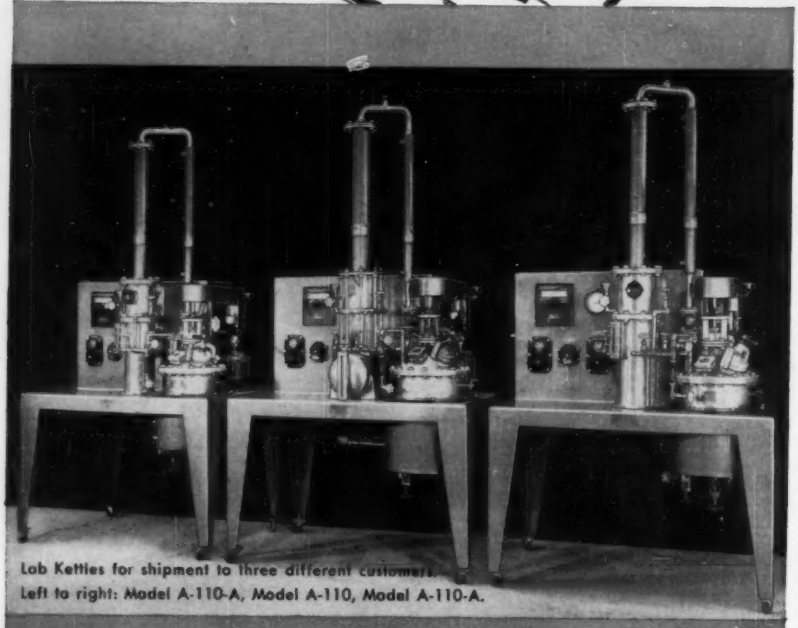
For Complete Details Write for Bulletin 35

BUFFALO METER CO.
2891 MAIN STREET
BUFFALO, N. Y.

Representatives in all leading industrial centers

Off they go!





Lab Kettles for shipment to three different customers.
Left to right: Model A-110-A, Model A-110, Model A-110-A.

as fast as we make 'em

BRIGHTON Synthetic Resin Lab Kettles are being produced at a remarkable rate to meet the rising demand. Models A-110 and A-110-A have become exceptionally popular because their versatility, accuracy of control and low cost make them especially attractive to those involved in synthetic resin production and experimentation.

Both models are outstanding examples of precision design and quality manufacturing. Model A-110-A is designed for both synthetic resins *and* organic reactions. Both are built of type 316 stainless steel. They have a variable speed drive with explosion proof motor and are electrically heated for pressure or vacuum cooking.

For complete information and costs write Dept. H.

BRIGHTON copper works inc.
820 state ave. • cincinnati 4 • ohio

DIVISIONS: P. C. DECKEBACH SONS CO., HAMILTON COPPER & BRASS WORKS.
est. 1914 • engineers • metalsmiths • machinists • designers, producers of chemical processing equipment

THIS MONTH'S

Firms in

New Lines

Motomco, Inc., chemical specialties manufacturers, New York, N. Y., has announced acquisition of the basic patent covering Metazene, used as the active ingredient in aerosol space deodorants. Production and distribution of Metazene was previously handled by Kilgore Chemicals Division of Atlantic Research Corp.

Armstrong Cork Co. will produce the full line of Fiberglas industrial insulations made by Owens-Corning Fiberglas Corp. Trade name of Armstrong's product is Armaglas.

New Names

Alco Products, Inc. is the new name of American Locomotive Co.

Alpha Molykote Corp. is the new name of the Alpha Corp., manufacturer of Molykote industrial lubricants.

F. W. Wakefield Brass Co. has changed its corporate name to the Wakefield Co.

New Locations

Witco Chemical Co. is opening new executice offices in the Chanin building, New York, N. Y.

Taylor Instrument Companies has moved its western regional sales headquarters and branch assembly plant from San Francisco to San Leandro, Calif.

Reflin Co., manufacturer of polyester–resin, reinforced plastic pipe, has moved administrative and manufacturing facilities from Gardena to San Diego, Calif.

Velsicol Corp. has moved its New York offices to the Empire State building.

Shea Chemical Corp. has moved its executive offices from Baltimore,

the News

M. A. Gibbons

Md., to Jeffersonville, Ind. In addition, the company has opened an office in New York City and has established an organic phosphates division at Adams, Mass.

American Cyanamid Co. has moved all of its Cincinnati, O., offices and warehouse facilities into a new building in Evendale, O., a suburb of Cincinnati.

Grace Chemical Co. has moved its main office from New York City to its plant location in Memphis, Tenn.

Olin Mathieson Chemical Corp. has chosen Little Rock, Ark., as the center of operations for two of its divisions, Western fertilizer division and Western sulphur and acids division.

Harshaw Chemical Co. has moved its New York branch office to Hastings-on-Hudson, N. Y.

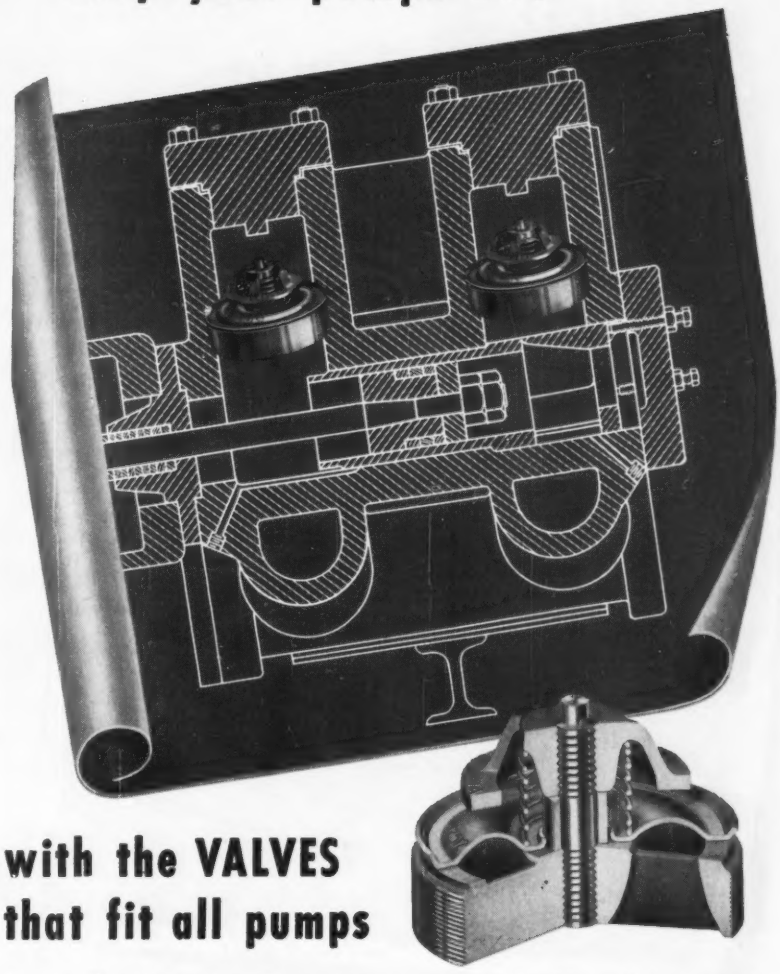
American Society for Engineering Education will move its editorial offices to the University of Illinois, site of its national headquarters, on July 1.

New Representatives

Ampco Metal, Inc. has selected the following companies as exclusive distributors for its bronze welding rod: Pacific Metals Co., Ltd., San Francisco and Los Angeles, Calif.; McDonald & Wilson Sales Co., St. Louis, Mo.; Miller Equipment Co., Cincinnati, O.; Red Arrow Sales Corp., Madison, Wis. In addition, Bushnell Machinery Co. has been franchised to distribute Ampco centrifugal pumps in the Pittsburgh Area.

Brown Fintube Co., Elyria, O., manufacturer of sectional hairpin and bundle-type heat exchangers, gas coolers and other fintube heat transfer products has announced the appointment

Keep your pumps FIT



with the VALVES that fit all pumps

Your old reciprocating pumps can be rehabilitated or adapted to new and severe service by fitting them with DURABLA Pump Valve Units.

The patented corrosion-resistant, non-warping, pressed metal valve, making only "point contact" on the stud or sleeve, cannot bind or hang up on the guard stem. The open-type guard assures free flow of liquid and eliminates any possibility of spring clogging from hardening liquids.

DURABLA Pump Valves will operate freely under extremes of high or low temperature, with highly corrosive fluids, and in any position. They will handle vacuums of one micron or discharge pressures of thousands of pounds per square inch.

Standard equipment on many pumps, DURABLA Valve Units are made in fifteen sizes, designed to meet over 300 variations in installation requirements. They will fit any reciprocating pump, new or old.

A DURABLA engineer will be glad to help you work out a plant survey covering your valve requirements. Write for bulletin or engineering assistance.

DM-2

DURABLA®

DURABLA MANUFACTURING COMPANY

114 LIBERTY STREET • NEW YORK 6, N. Y.

Here's how to Combine Simplicity and Economy in

Waste Treatment



Simplicity and relative economy sum up this unusual waste treatment installation for a large Southern paper mill. Primarily installed for suspended solids removal from general mill effluent, it is also doing a good job of B.O.D. reduction. The 300′ dia. Dorr Clarifier installed in an economical 500′ earthen basin removes approximately 90% of suspended solids . . . with a B.O.D. reduction of approximately 33%.

This Dorr Clarifier-earthen basin team is suited principally for use as a primary treatment unit. Additional treatment steps can be added as needed, without affecting the initial Clarifier installation.

If you have problems involving any phase of the separation of finely divided solids in suspension . . . or ion-exchange . . . or fluidizing techniques — chances are that Dorr-Oliver and its world-wide organization can help you.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

FIRMS . . .

of the recently formed firm of Benson, Funk & Associates as sales and engineering representatives for the New England territory.

CDC Control Services, Inc., specialists in control instrumentation, has designated Exploitation de Produits Industriels, SEPI, of Paris, France, as exclusive sales representative. SEPI's territory will comprise France, French North Africa, West Germany, Italy, Luxembourg, Belgium and the Netherlands.

Childers Manufacturing Co., Houston, has appointed J. P. Maguire Co., New Orleans, La., and Power Equipment Co., Memphis, Tenn., as engineering representatives for its aluminum weatherproof jacketing.

Cooper Alloy Foundry Co., Hillside, N. J., has appointed John Wilfert Co., Brooklyn, N. Y., as authorized distributor for Cooper Alloy valves, fittings and accessories.

Gates Engineering Co. of Wilmington, Del., has announced the appointment of Ross Roy, Inc., N. Y., as its advertising agency.

Graver Water Conditioning Co., N. Y., has appointed Allen-Shuff Corp. of Memphis and Nashville, Tenn., as sales representative.

R. G. LeTourneau, Inc. has named Stanley E. Morris Co., Los Angeles, Calif., as distributor of LeTourneau electric hoists and jib cranes.

Lustro Plastics Tile Co. has selected Norman Malone Associates, Akron, O., as its advertising agency.

Naresco Equipment Corp., equipment sales subsidiary of National Research Corp., has appointed the Hainge Co., Inc. as its Gulf Coast sales representative.

Pace Electrical Instruments Co., Inc., Glendale, L. I., has ap-

RESEARCH pays off in buildings, too!

Announcing

Design 12

World's finest standard prefabricated building!

This new concept in design *guarantees* a better, longer-lasting building for any operation at less cost.

INDUSTRY AGRICULTURE COMMERCE WAREHOUSING

An Exclusive Product of

McCLOSKEY COMPANY OF PITTSBURGH

engineers and builders

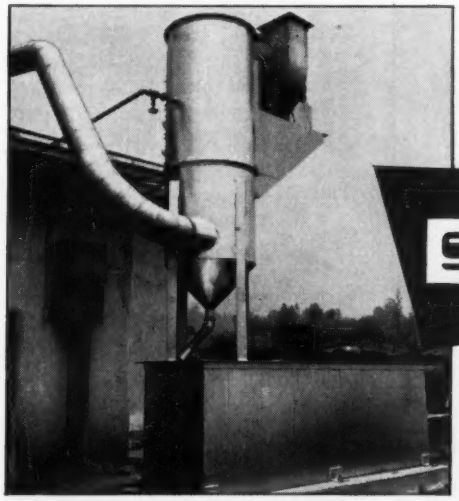
PITTSBURGH 1, PA.

Shipment from plants at AMBRIDGE • ELMIRA • TRENTON • GARY
MEMPHIS • MINNEAPOLIS • PITTSBURGH • BIRMINGHAM • ROANOKE

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

EXPLOSIVE DUSTS

FUMES AND VAPORS MADE SAFE WITH MULTI-WASH COLLECTORS



The explosion hazard is ever present in many chemical process plants. Control of this hazard has been achieved by many big-name processors with the Multi-Wash system of collection.

The versatility of the Multi-Wash Collector, its simplicity and efficiency, make it the most economical buy in its field.

Not only will Multi-Wash solve your dust, fume or vapor problem, but return the investment in recovery of valuable by-products.

Be sure to get all the answers before you allocate any money for dust control equipment.

Your nearest Schneible engineer is at your service, or if you like, call the home office, collect.

SCHNEIBLE

Write for Bulletins Nos. 551 and 610—No obligation of course.

CLAUDE B. SCHNEIBLE CO.
P. O. Box 81, North End Station
Detroit 2, Michigan

EUROPEAN LICENSEE: ELEX S. A., ZURICH, SWITZERLAND
CABLE ADDRESS FOR FOREIGN ENQUIRIES: CESCO

READ AIR VELOCITIES

instantly... accurately... anywhere...



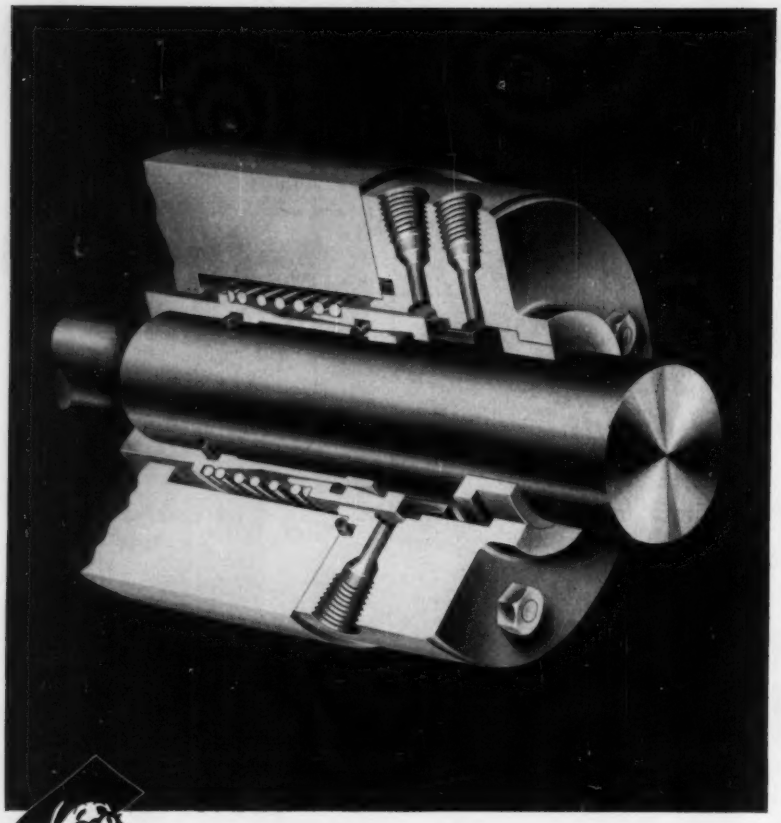
...WITH THE

ALNOR VELOMETER

Alnor Velometer, a precision-built, self-contained, portable instrument, gives you instant, *accurate* readings of air velocities anywhere—in plants, mines, mills or laboratories. Measures speed of air flow through ducts, grilles, furnaces, spray booths or in the open. This rugged instrument needs no special care or delicate handling—anyone can use it and get accurate readings. Needs no calculations or reference charts. Available in a wide variety of scale ranges, and with a full assortment of jets and fittings for every application. You'll want full details and prices, so write for Bulletin 2448-G, Illinois Testing Laboratories, Inc., Room 559 420 No. La Salle St., Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY





Stumped?

by pump leakage

Design pump leakage out of your processes by specifying Sealol-Flexibox Mechanical Shaft Seals on all your rotary and centrifugal pumps. Flexibox eliminates gland leakage and shaft scoring — and it positively stops dangerous or wasteful loss of valuable product.

The Flexibox Mechanical Shaft Seal is adaptable to shaft diameters up to 6 inches, rotary speeds to 1800 RPM, temperatures to 500° F., and pressures up to 2000 psi. Send for Bulletin 10; also consult us for engineering data and recommendations on your shaft sealing problems.

SEALOL CORPORATION, 183 POST ROAD, PROVIDENCE 5, R. I.

Baton Rouge • Charleston (W. Va.) • Chicago • Cleveland • Corpus Christi • Dallas
Houston • Los Angeles • New Orleans • New York City • Philadelphia • San Francisco
St. Louis • Tulsa • Edmonton — Toronto (Can.) • Manchester (Eng.) • Paris • Frankfurt

SEALOL

THE BALANCED PRESSURE SEAL

FIRMS . . .

pointed the following firms to handle industrial accounts: C. R. Strassner Co., Los Angeles, Calif.; A. J. Nelson Co., Denver, Colo.; J. Clancy & Co., Angola, Ind.; Morris F. Taylor Co., Silver Springs, Md.; Wolfe-Marsey Sales Co., Rochester, N. Y.; Northwestern Agencies, Inc., Seattle, Wash.; Kaelber & Mack, Manhasset, L. I., N. Y.

Parker Appliance Co. has named Industrial Piping Supply Corp., Bessemer, Ala., and Ritter Engineering Co., Pittsburgh, Pa., as distributors for its line of tube and pipe fittings.

Rhodia, Inc. has announced the appointment of Naugatuck Chemical Division of Dominion Rubber Co., Ltd., as sales and technical representative in Canada.

Baker Castor Oil Co., Los Angeles, has appointed Paul W. Wood Co. as exclusive sales representative for the San Francisco Bay Area to handle sales and service for the paint, plastics, lubrication, rubber and chemical industries.

New Facilities

Union Carbide and Carbon Corp. is building new research laboratories at Parma, O., to be managed by National Carbon Co., a division.

Bakelite Co., a division of Union Carbide and Carbon Corp., has completed facilities at Ottawa, Ill., for more than doubling production of Krene vinyl cast film.

Parke, Davis & Co. plans to build a $2 million manufacturing laboratory at Brockville, Ont.

Atlas Powder Co. sold its Revolite division to Raybestos-Manhattan, Inc. for an undisclosed sum.

Electro Refractories & Abrasives Corp. and Strategic Materials Corp. are negotiating a partnership for mining, processing and

for **bulk** MATERIALS HANDLING



One unit feeds, conveys, elevates through horizontal, vertical or inclined planes . . . quickly, efficiently, economically. It's the . . .

G-W FLOWMASTER

. . . a self-loading, self-discharging system of steel flights . . . moving on an endless all-steel chain . . . through a dust-tight casing. Unusually versatile. Write today.

Free! Write for G-W's idea book on engineered materials handling systems.

GIFFORD-WOOD CO.

HUDSON, N. Y. AND PRINCIPAL CITIES



WIRE-MESH PRODUCTS

for all filtering and straining applications.
All meshes, all weaves, all alloys.



Send Specifications for an estimate. Department 15

WIRE PRODUCTS jelliff SINCE - 1860

THE C. O. JELLIFF MANUFACTURING CORP. SOUTHPORT, CONN.

TEAR OUT AND MAIL!

YES! I would like to know more about

STAR-KIMBLE

Special Motor Designs

☐ If your sales engineer will give me a ring, I'd like to talk to him AND IN THE MEANTIME, you might send me your bulletin on Standard

☐ SQUIRREL CAGE
☐ BRAKEMOTORS
☐ WOUND ROTOR
☐ D-C MOTORS
Generators, M-G Sets

My name is _____

They call me a _____ *(title)*

At _____ *(company)*

_____ *(street address)*

_____ *(city)* *(zone)* *(state)*

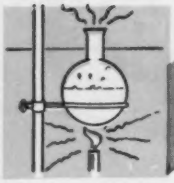
STAR-KIMBLE

MOTOR DIVISION

Miehle Printing Press and Mfg. Co.
207 Bloomfield Ave., Bloomfield, N. J.



ACIDS, CORROSIVES AND SOLVENTS



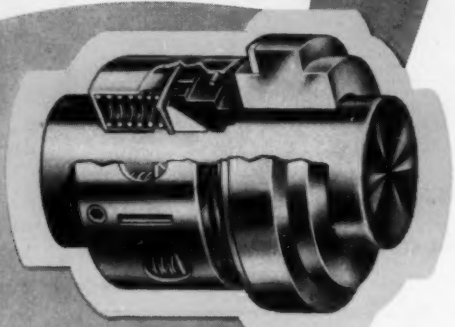
HOT LIQUIDS



TOXIC GASES AND VAPORS

JOHN CRANE

TYPE 9 MECHANICAL SEAL



WILL HANDLE THEM ALL!

Wedge and sealing rings molded from DuPont Teflon assure efficient, safe handling of all known industrial chemicals and corrosives at temperatures varying from −120°F. to +500°F. Spring and metal parts are furnished in the metallurgical specification best suited to the particular service. In every way, you get a mechanical seal that is "John Crane" engineered to your requirements—no matter how tough!

The Type 9 Seal has and continues to solve innumerable problems where difficult-to-handle liquids and gases are involved . . . at pressures up to 750 psi. It can do the same for you.

Use the Type 9 Seal on all rotating shaft equipment—centrifugal and rotary pumps, mixers, agitators, autoclaves, other equipment.

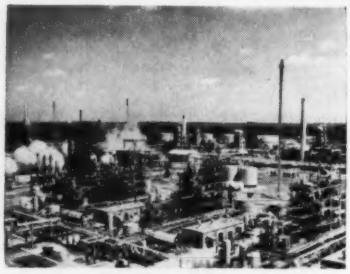
REMEMBER: ***Your toughest problem can be the Type 9's next success story.*** **Send for full details today.**

Crane Packing Co., 1809 Belle Plaine Avenue., Chicago 13, Illinois.
In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

FIRMS . . .

marketing of feldspar, mica and other industrial minerals. They plan a joint operation of Spar-Mica Corp. Ltd., Montreal, Can.



U. S. Rubber Disposal Commission has turned over 25 war-built synthetic rubber plants to private industry. Firms involved in the transfer, plant and location, capacity and cost (where figures are available) include: **American Synthetic Rubber Co.,** 44,000-ton GR-S plant, Louisville, Ky.; **Copolymer Rubber & Chemical Corp.,** 49,000-ton GR-S plant and 23,000-ton butadiene plant, both at Baton Rouge, La.; **Esso Standard Oil Co.,** 43,000-ton butyl rubber plant, Baton Rouge, La., $16 million; **Firestone Tire & Rubber Co.,** GR-S latex plant, Akron, O., $2.8 million and 99,600-ton GR-S plant, Lake Charles, La., $13.1 million; **Food Machinery & Chemical Corp. and Tennessee Gas Transmission Corp.** (joint owners), 78,000-ton butadiene plant, Houston, Tex., $25.9; **Goodrich-Gulf Chemical, Inc.,** 90,000-ton GR-S plant, Port Neches, Tex., $41.4 and one-half interest—along with Texas-U. S. Chemical Co.—in 205,000-ton butadiene plant, Port Neches, Tex., **Texas-U. S. Chemical Co.,** 89,400-ton GR-S plant, Port Neches, Tex.; **Goodyear Synthetic Rubber Co.,** 600-ton GR-S plant, Houston, Tex., $13 million; **Goodyear Tire & Rubber Co.,** GR-S plant, Akron, O., $2.6 million; **Humble Oil & Refining Co.,** 49,000-ton butadiene and 43,000-ton butyl rubber plants, Baytown, Tex., $28.5 million (for both plants); **Koppers Co., Inc.,** 128,000-ton alcohol-butadiene plant, Kobuta, Pa., $2.3 million; **Petroleum**

A.C.M.I. BORESCOPES

for close-up visual inspection of internal surfaces and hidden parts



A.C.M.I. Borescopes are available in 4 angles of vision (as above)—in diameters of .120" to 4.00"—in lengths of 4" to 720". Special models for special problems.

A.C.M.I. Borescopes permit close-up visual examination of interior areas and surfaces not otherwise visible. They save time and money, and prevent costly dismantling. • Each Borescope is a compact, self-illuminated industrial telescope of highest quality, employing a precision optical system, that produces a flat visual field. Lens systems are fully corrected for color, spherical aberrations, and coma, with all lens surfaces coated to increase light transmission

Write for free informational folder, or tell us your problem.

American Cystoscope Makers, Inc.
1241 LAFAYETTE AVENUE NEW YORK 59, N. Y.

CLEVELAND

WIRE CLOTH . . . WIRE SCREENS*

*HEAVY DUTY

40 YEARS SERVICE TO INDUSTRY PRODUCING ACCURATE, LONG-LIFE VIBRATING SCREEN SECTIONS

Cleveland Wire Screens maintain rigid accuracy of openings, provide longer, productive service, and are accurately woven of tough, yet ductile abrasion-resistant steel. We weave and fabricate strainer and filter screens to individual job requirements.

WIRE CLOTH
Full range of openings from 6" clear to .0017" in steel, galvanized steel, copper alloys, stainless steel, chrome steel, monel, nickel, aluminum and silver.

WEAVES
Weaves include plain, twilled, dutch or corduroy, stranded cable and locked crimp. Industrial wire cloth designed and produced for individual problem requirements.

STRAINERS AND FILTERS



CUSTOM-BUILT
Custom-built and adapted to individual needs. Available in all commercial metals and alloys.

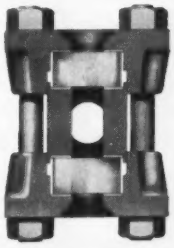
Write for Bulletin 5, 6 and 7.

THE CLEVELAND WIRE CLOTH & MFG. CO.
3573 E. 78th STREET • CLEVELAND 5, OHIO

Strahman

HIGH PRESSURE GAUGES

USED IN
REFINERIES
AND
CHEMICAL PLANTS
THROUGHOUT THE WORLD



THRU VISION



REFLEX
Single or Multiple Sections

TUBULAR

Gauge Cocks
•
Large Chamber Reflex Gauges
•
Heated or Cooled Gauges



SEND FOR
COMPLETE CATALOGUE

STRAHMAN VALVES, Inc.
16 Hudson St., New York 13, U.S.A.

mixing the Day way at Goodyear.....



DAY BLENDERS . . . selected by the Goodyear Tire & Rubber Co. because these blenders are best suited for their new dry-mixing method for Vinyl compounds. Hundreds of other manufacturers all over the country are profiting from the long, dependable service of these blenders.

Designed for fast, efficient operation, Day Blenders can be equipped with a variety of agitators for your specific product. Anti-friction bearings, metallic seals, spray pipes, flush valves are available as optional equipment.

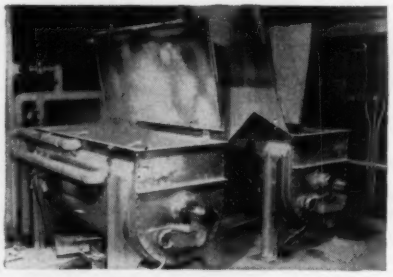


Photo shows two of many Day Blenders being used at the Goodyear Tire & Rubber Co. for mixing a variety of compounds.

Day Blenders are available in capacities from one cubic foot to 2300 cubic feet. Plain, galvanized or stainless steel tanks. Jacketing is optional. Write for Bulletin 800.

FOUNDED 1887

in mixing equipment **DAY** *means longer life span*

THE J. H. DAY COMPANY
INCORPORATED
4932 BEECH ST., NORWOOD, CINCINNATI 12, OHIO
Division of Cleveland Automatic Machine Company

Quality equipment for baking, paint and varnish, printing ink, chemical, rubber, pharmaceutical, cosmetics, paper and pulp, explosives, food, ceramics, candy, soap, sugar and milk products.

Eastern Canada: Brantford Oven & Rack Co., Ltd., Brantford, Ontario
Western Canada: British Canadian Importers, Vancouver, British Columbia
Mexico: T. de la Pena e Hijos, S.A., Nazas 45-A, Mexico 5—D.F.

FIRMS . . .

Chemicals, Inc., 63,000-ton butadiene plant, Lake Charles, La.; **Phillips Chemical Co.**, 71,200-ton petroleum-butadiene and 66,000-ton GR-S copolymer plants, Borger, Tex., $25.4 million (for both plants); **Shell Chemical Co.**, three plants—copolymer, butadiene, styrene—at Los Angeles, Calif.; **Standard Oil of Calif.**, butadiene plant, Los Angeles, Calif., $2 million; **U. S. Rubber Co.**, two plants—GR-S latex and dodecyl mercaptan—at Naugatuck, Conn.; $4 million (for both plants); **United Carbon Co.**, 44,000-ton copolymer plant, Baytown, Tex., $7.2 million.

Kaiser Gypsum Co., Inc., wholly owned subsidiary of Permanente Co., will start construction of a $5 million gypsum board plant and plaster mill at Pittsburg, Calif.

B. F. Goodrich Co. is planning to install a cobalt-60 radiation unit at Brecksville, O., for close study of nuclear radiation.

Gonzales Chemical Industries, Puerto Rico, expects to have its $12.3 million anhydrous ammonia plant—at Guanica harbor—on stream by January, 1957.

Tuloma Builders, Inc. will build a gas processing plant in Acadia parish, La., for Sunray Oil Corp.

U. S. Rubber Co. plans to double the size of its foam rubber plant in Santa Ana, Calif., to permit manufacture of foam rubber mattresses on the West Coast and expand production of foam cushioning for furniture.

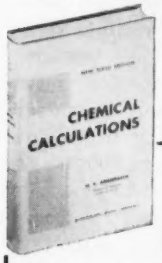
Lummus Co. has been awarded an engineering and construction contract for an 18,000 bbl.-a-day petroleum refinery near Turku, Finland. It will be operated by Neste Oy, a firm controlled by the Finnish government.

Houdry Process Corp. has established a new chemical division to manufacture and sell certain types of catalyst used in petro-

CHEMICAL CALCULATIONS

JUST PUBLISHED

A handy reference on common calculations to help you solve a wide variety of chemical problems. Includes scores of illustrative examples dealing with equation-writing, thermometric calculations, gas-volume relations, oxidation reduction, gram-equivalent, molar and normal concentration, electro-chemistry, etc. **Sixth Edition by H. V. Andseron, Prof. of Chem., Lehigh Univ. 320 pp., 415 illus., $4.75.**



ELEMENTARY CHEMICAL ENGINEERING

A simply-written guide giving you broad over-all knowledge of chemical engineering that you need and use every day. Step by step, you are taken through basic chemical engineering unit operations —flow of fluids, heat transfer, evaporation, distillation, filtration etc. Production of sulfuric acid, fuel and industrial gases and electrolytic processes and nuclear reactions are described in basic terms. Includes details on piping, valves, fittings, pumps, steam traps, conveyors, evaporators, packings and driers, etc. Profits and cost in plant operation are also covered. **By M. S. Peters, Prof. of Chem. Engr., Univ. of Ill. 322 pp., 65 illus., $8.00.**

MOLECULAR VIBRATIONS

Just Published!

Covers the theory of the vibrations of polyatomic molecules, and its applications to the interpretation of infrared and Raman spectra. Develops the essential elements of this theory, starting from its simplest form and advancing to fairly elaborate and powerful theorems used in more complicated applications. **By E. Bright Wilson, Jr., J. C. Decius, and Paul C. Cross. 308 pp., 56 illus., 32 tables, $8.50.**



PULP and PAPER MANUFACTURE

Vol. 4—Auxiliary Paper Mill Equipment

Just Published!

Discusses the principles, methods, and applications of all the modern auxiliary equipment that contributes to more efficient production of pulp and paper. Covers those departments that supply water, steam, power, electricity, ventilation, handling of fluid and solid materials, and lubrication. Prepared by experts representing the Pulp and Paper Industry of the U.S. and Canada. **Edited by J. Newell Stephenson. 732 pp., 343 illus., 36 tables, $9.00.**

10 DAYS' FREE EXAMINATION

McGraw-Hill, Attn: H. W. Buhrow, Industrial & Business Book Dept., 327 W. 41st St., N. Y. C. 36.

Send me book(s) checked below for 10 days examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs and return unwanted book(s) postpaid. (We pay delivery costs if you remit with this coupon—same return privileges.)

- ☐ Anderson—Chemical Calculations—$4.75
- ☐ Peters—Elementary Chemical Engineering—$6.00
- ☐ Wilson, Decius & Cross—Molecular Vibrations —$8.50
- ☐ Stephenson—Pulp and Paper Manufacture Vol. 4—$9.00

(Print)
Name .....
Address .....
City .....Zone ....State .....
Company .....
Position .....

For price and terms outside U. S. write McGraw-Hill Int'l., N.Y.C. CE-7

AUTO-LITE

TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.



Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS

SHADOGRAPH Scales Provide PRECISION Weighing FAST!



SHADOGRAPH's shadow-edge indication is projected by a beam of light, eliminating all friction of indicating mechanism and increasing visible accuracy over 300%. Greater speed in reading is achieved through reduction of lever movement and the action of an adjustable damping device which brings indicating beam to rest quickly. Acurate readings without parallax. Available in a number of models with capacities from 4 oz. to 25 lbs. and sensitivities from 1/500 oz. and up.

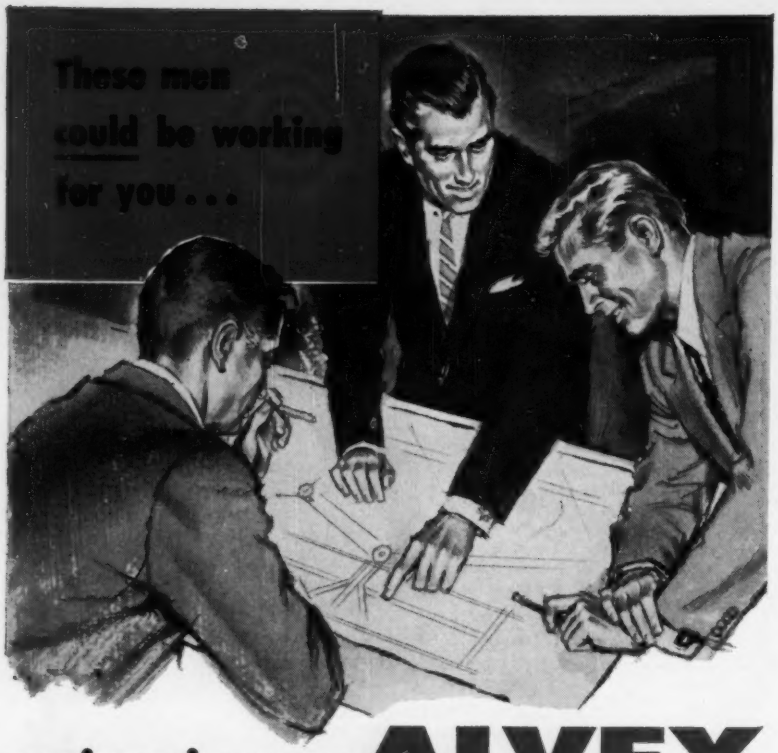


Exact Weight Scales

Better quality control
Better cost control

THE EXACT WEIGHT SCALE COMPANY

901 W. Fifth Avenue, Columbus 8, Ohio
In Canada: P. O. Box 179, Station S, Toronto 18, Ont.



engineering your **ALVEY**
CONVEYOR INSTALLATION

This group of experienced engineers is typical of the ALVEY "team" that plans your package-handling system. They study your operation . . . from **receiving** to **shipping.** They design a conveyor system that is fitted to your specific needs. And, they supervise every step of its development and installation.

This personalized "custom-engineering" is the big reason why ALVEY conveyor systems produce such dramatic benefits in improved production, man-hour savings and safety. They take advantage of every opportunity.

Why not see it work in your plant? We will be happy to have an ALVEY engineer call on you. Call your nearest ALVEY office, or write us direct.



Every time you MANhandle a product, you add to its cost . . . without adding to its value.

So for profit's sake . . . put your packages on

ALVEY

ALVEY CONVEYOR MANUFACTURING COMPANY
9343 Olive Street Road, St. Louis 24, Missouri
Branch Offices in Principal Cities

188A

FIRMS . . .

leum and chemical catalytic processes.

Bonneville Power Administration has extended—for one year—the effective date of a 20-year power contract with Harvey Aluminum Corp. for delivery of 40,000 kw. of firm and up to 80,000 kw. of interruptible energy, when available, for the aluminum reduction plant Harvey proposed for The Dalles, Ore.

Dow Chemical International Ltd. has opened a new Far Eastern sales office in Tokyo, Japan.

Koppers Co., Inc. has been awarded a contract to build a battery of 30 chemical-recovery coke ovens for U. S. Pipe and Foundry Co., Birmingham, Ala.

Texas Co. is constructing three new buildings—two at Beacon, N. Y.; the other, at Port Arthur, Tex.—as the first phase of an extensive expansion of research and testing facilities.

Selas Corp. of America has just started work on a new $1 million plant at Dresher, Pa. All research and development activities will be concentrated in a single building designed to provide coordinated laboratory facilities. Production facilities will be housed in a second building, administrative offices in a third.

Hidalgo Chemical Co.'s rapid tax amortization on a $3.4 million addition to its gas syntheses plant, Brownsville, Tex., has been approved at the rate of 70%.

Food Machinery and Chemical Corp.'s offer to acquire the common stock of Chiksan Co. has been accepted by holders of more than 93% of the outstanding shares of Chiksan common stock.

Vulcan Stamping & Mfg. Co., manufacturer of steel shipping pails and drums, is now constructing a new addition to its plant which will allow all rail-



'scuse us
for being chesty, but...

. . . we just can't help crowing about reader-response to CE's first *Annual Inventory Issue.*

A chemical engineer from Brooklyn calls it . . . *"invaluable already, and without precedent."* A South Carolina plant manager stopped in to tell us . . . *"Yo'all done yo'self real proud."* A Dallas man swears . . . *"the editor musta come from Texas."*

Others went into greater detail—on content, arrangement of editorial sections, Reader Service—even the quality of the advertising. Comments and opinions were all over the lot. And they're still coming in.

What do you say? It's your magaziné and we're wide open for suggestions. We'd like your ideas . . . for the *1955 Annual Inventory Issue* of CHEMICAL ENGINEERING.

ANNUAL INVENTORY ISSUE

Chemical Engineering

ABP ABC

A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

Are you paying for QUALITY?
Are you getting QUALITY?

CAMCO

THE QUALITY LINE IN STAINLESS STEEL FITTINGS



When you specify CAMCO on your stainless steel fitting requirements you are specifying QUALITY — without paying a premium. These fittings are priced in line with competition. How do we do it? CAMCO concentrates ALL of its facilities, efforts and thinking to the manufacture of stainless steel fittings only. The resulting economies are translated into quality and passed on to you.

FLANGES: Manufactured to both the ASA and MSS standards covering stainless steel flanges. All flanges to ASA specifications are DROP FORGED and are permanently marked with size, pressure rating, material identification, trademark, and heat numbers — (the key to certificates of analysis and corrosion coupons when required). All flanges to MSS standards are machined from DROP FORGINGS to 4" IPS, (Weldneck flanges to 1" IPS only) and from sound castings in sizes 5" IPS and higher.

SCREWED FITTINGS: All ells and tees to ¾" IPS inclusive and all cylindrical fittings to 2" IPS inclusive (caps, couplings, plugs, bushings and unions) are manufactured from DROP FORGINGS in our 150 lb. line of fittings. Independent outside tests have indicated that these fittings can be rated 1000 lb. CWP. Fittings in higher sizes of our 150 lb. line are machined from sound castings.

AVAILABILITY: Sold and stocked by distributors throughout the country and backed by large stocks at the plant for requirements in excess of normal.

Use attached coupon for Flange Dimensional Slide Rule and Catalog covering complete line.

MAIL TODAY

CAMCO Products, Inc., 445 State Street, North Haven, Conn.
Gentlemen: CE

- ☐ Please send Flange Dimensional Slide Rule.
- ☐ Catalog #653 covering complete line.
- ☐ Furnish address of area distributor.
- ☐ Put us on your mailing list to receive your stock list.

Name_____
Company_____
Address_____
City and State_____



THE Quality LINE IN STAINLESS

CAMCO

PRODUCTS, INC. 445 STATE STREET NORTH HAVEN, CONN.

an ACCO product

Helicoid Gages



For day-in, day-out Sustained Accuracy —for the life of the gage— HELICOID Quality costs you less!

• It's the basic design of HELICOID Gages that makes them outlast and out-perform ordinary gear-tooth gages. This enduring accuracy is evidenced by the smooth rotation of simple spiral roller and cam.

If you use gages it will pay you to investigate HELICOID performance records. There is a HELICOID long-life gage to meet every type of pressure indicating requirement. Ranges are to 20,000 p.s.i. and vacuum or compound.

Write today for Helicoid G-2 Catalog



Dials may be black, white or radiant.



Wall or stem mounting cases—flush panel or flangeless cases.



ACCO

TRADE MARK

Helicoid Gage Division
AMERICAN CHAIN & CABLE

929-E Connecticut Avenue • Bridgeport 2, Connecticut

FIRMS . . .

road freight cars and additional motor trucks to be loaded inside, under cover.

Claud S. Gordon Co., Chicago, Ill., has completed an addition to its plant at Richmond, Ill. The addition will double the company's manufacturing facilities at this plant where it produces Serv-Rite thermocouple wire, pyrometers, pyrometer and thermocouple accessories.

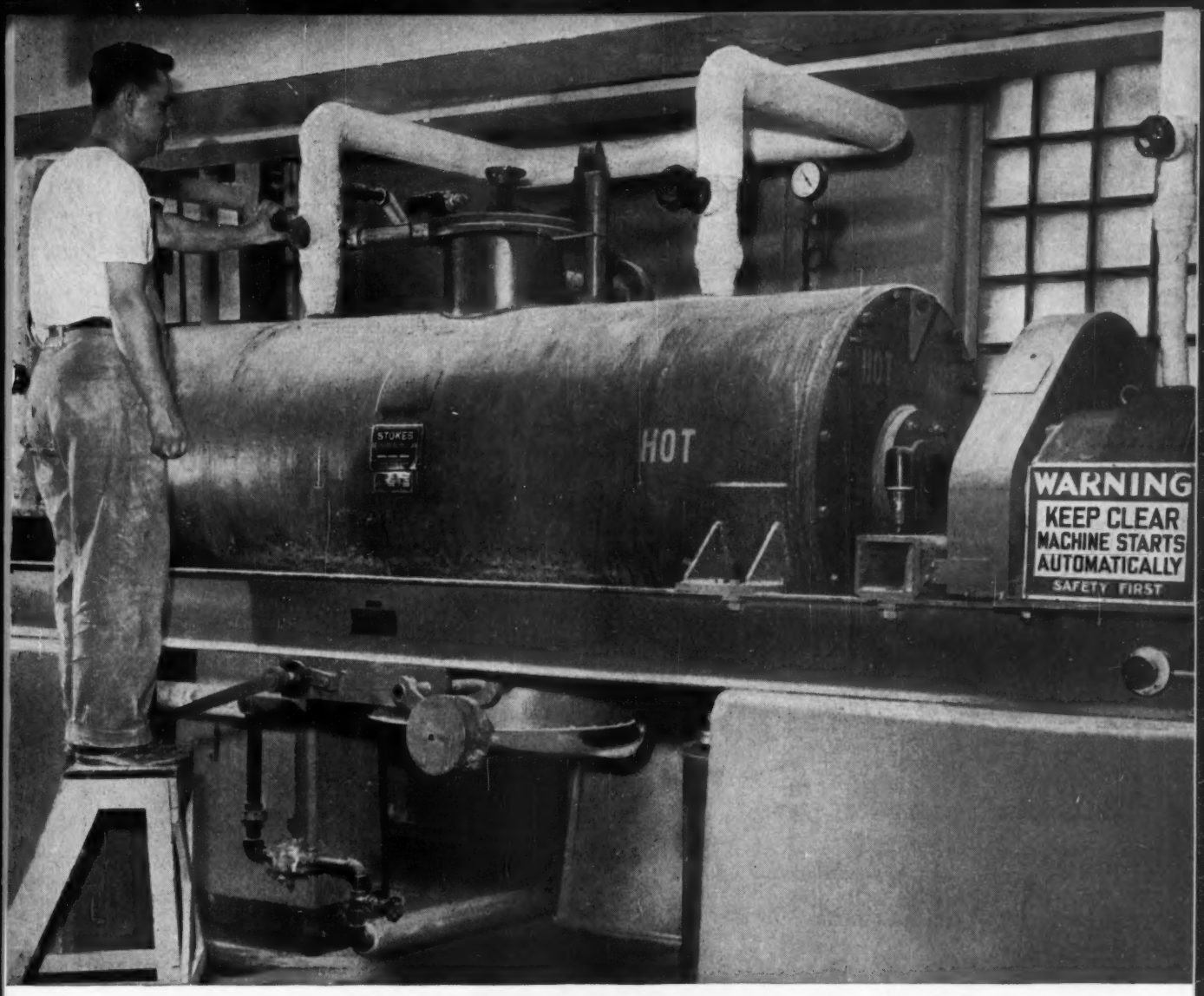
Fluor Corp., Ltd., Los Angeles, Calif., has been awarded a contract by Texas Natural Gasoline Corp. for the design, engineering and construction of gasoline plant facilities in Coke County, Tex. A second contract has been awarded to Fluor by Ketona Chemical Corp. for the design and construction of a nitric acid neutralizing and ammoniated nitrate of ammonia facilities at Ketona's Tarrant, Ala., job site.

Poor & Co. has established a new division, Crusher Engineering, with headquarters in Philadelphia, Pa. This division will make available a complete line of crushers, breakers and pulverizers to industrial markets.

Paint Research Laboratory of Harlan Associates, San Francisco, has opened a $30 thousand laboratory in Los Angeles which will specialize in investigations of coating failures; preparation of painting specifications, inspection and enforcement; testing and development work for paint, plastic and other industries.

Dewey and Almy Chemical Co., Division of W. R. Grace & Co., has purchased 200 acres of land near Greenville, S. C., for construction of a plant to manufacture Cryovac plastic bags.

Cudahy Packing Co., Omaha, Neb., has concluded a deal to sell its Old Dutch Cleanser Division to Purex Corp., Southgate, Calif. Deal involves an undisclosed amount of Purex stock and cash for Old Dutch assets.



Weed-killer production problem solved by STOKES vacuum dryer

A leading chemical manufacturer asked us, "What equipment can we use to dry 6 tons per day of a heat-sensitive weed-killer from a true solution containing 67% dissolved solids to a crystalline product of 99.75% solids? Maximum allowable temperature is 50° C and we must crystallize and dry in one operation."

Stokes engineers developed the answer from broad experience with drying problems . . . confirmed it by tests on the chemical in the fully equipped Stokes laboratory . . . recommended a Stokes rotary vacuum dryer sized to give the needed production on a predetermined drying cycle. The unit was purchased and is now on the production line.

This combination of engineering knowledge and laboratory research—the result of 40 years in the design and application of complete vacuum processing systems—is available to all chemical manufacturers. A typical Stokes Rotary Vacuum Dryer is illustrated. Write for informative literature on Stokes Vacuum Drying Equipment, Catalog No. 720, and for the new booklet on Stokes Laboratory facilities, Bulletin No. 640.

F. J. Stokes Machine Company,
Philadelphia 20, Pa.

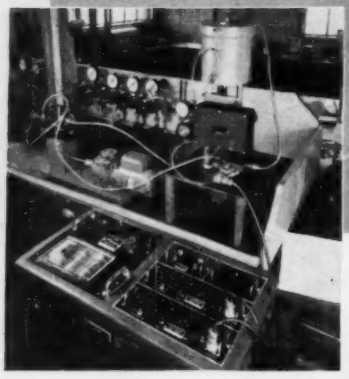
STOKES



At the Mass. Institute of Technology Machine Tool Laboratory the effect of variables such as cutting fluid, tool geometry, speed and feeds, and tool material are measured and recorded, using a dynamometer and Sanborn two-channel System. Such records for various lathe operations, as well as many other cutting operations, provide valuable insight into the whole metal cutting process.

...from lathe cutting forces to telemetered aircraft data...

SANBORN Oscillographic RECORDING SYSTEMS prove their versatility



At Moore Products input and response of their Valve Positioner, a pneumatic instrument widely used on diaphragm top-work valves and power cylinders, are recorded on a Sanborn two-channel System. Impulses from a pneumatic sine wave generator, of frequencies as high as 20 cps, are fed through a transducer to one channel, with valve stem response recorded by the second channel from a strain gage pickup.

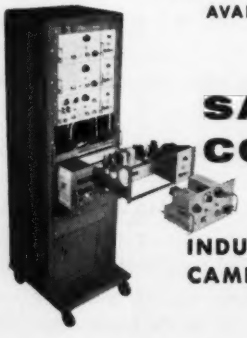




At Edwards Air Force Base, California, this U. S. Air Force telemetering van received and recorded information transmitted from various pickups and transducers in the new delta wing Convair YF-102A during flight. Photos of van interior show eight Sanborn four-channel recording systems in rear, and close-up of four of the systems. Thus equipped, the van could receive data which would affect the design and performance of the YF-102A, a faster-than-sound, all-weather interceptor built by the Convair Division of General Dynamics Corporation.

These typical two- to 32-channel applications of Sanborn oscillographic recording systems give an indication of the tremendous scope of this versatile equipment. Elsewhere, Sanborn 1-, 2-, 4-, 6- and 8-channel systems and components are used in meteorological research ... quality control programs ... instrument and machinery field testing.

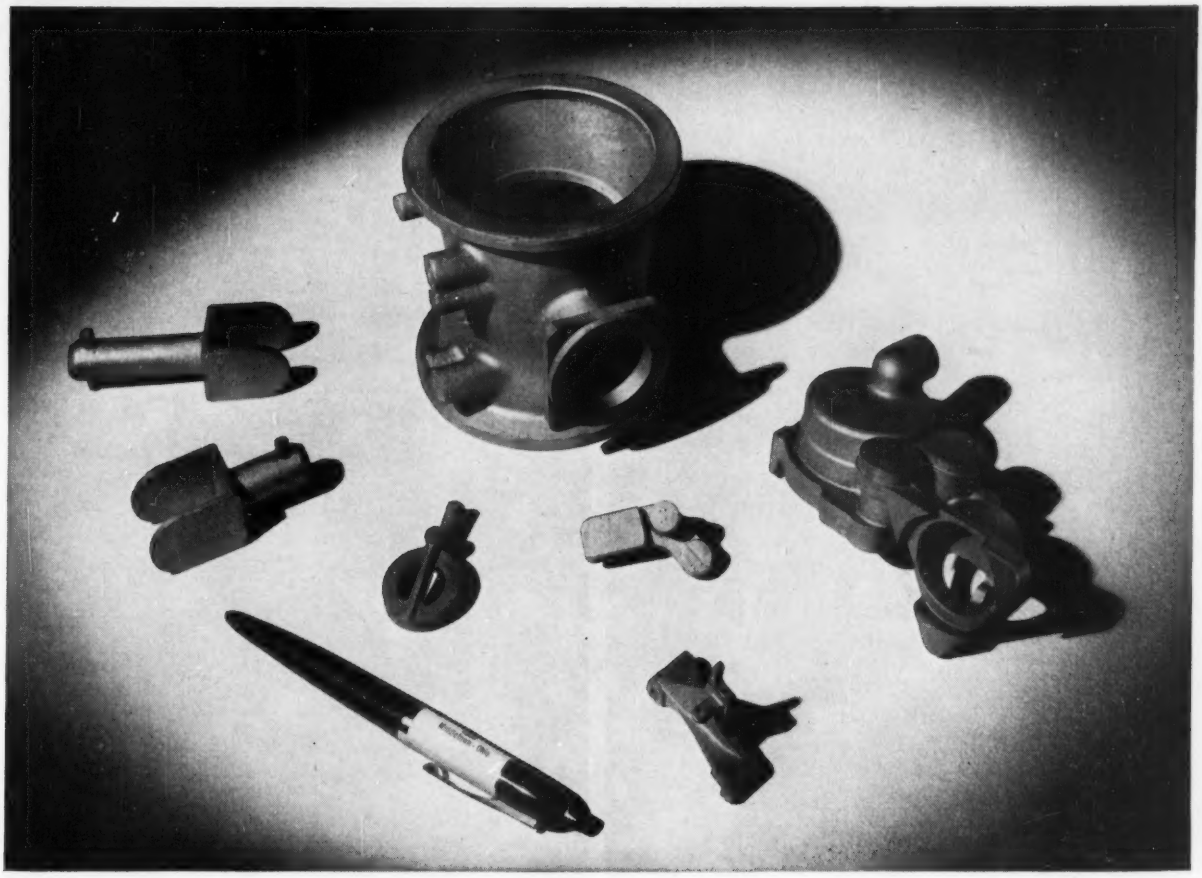
Flexibility of Sanborn design permits interchangeable amplifiers and preamplifiers to meet *individual* recording requirements with greater over-all efficiency and economy. Other Sanborn features include *inkless* recording in true rectangular coordinates, high torque galvanometer movement, time and code marking, and numerous chart speeds.



CATALOG AND TECHNICAL DATA AVAILABLE ON REQUEST

SANBORN COMPANY

INDUSTRIAL DIVISION
CAMBRIDGE 39, MASS.



Stainless castings show up to 190,000 psi strength after 875 F hardening treatment

Foundries report ultimate tensile strength as high as 190,000 psi in investment castings of Armco 17-4 PH Stainless Steel. This precipitation-hardening grade is easy to cast. It fills thin sections and details nicely, surface finish is good and tolerances small.

READILY MACHINABLE Armco 17-4 PH investment castings machine readily to an excellent surface finish. The subsequent 1-hour hardening treatment at 875 degrees F will not distort the part nor damage the surface. It causes only a slight discoloration.

NUMEROUS SUPPLIERS Armco does not make castings. If you are interested in high-strength, low-temperature hardening castings with high corrosion resistance, just fill out the coupon. We'll send you a list of suppliers of investment castings and other types made of Armco 17-4 PH Stainless Steel.

Armco Steel Corporation 1345 Curtis Street, Middletown, Ohio
Send me a list of producers of castings of Armco 17-4 PH Stainless Steel.

Name:_____

Firm:_____

Street:_____

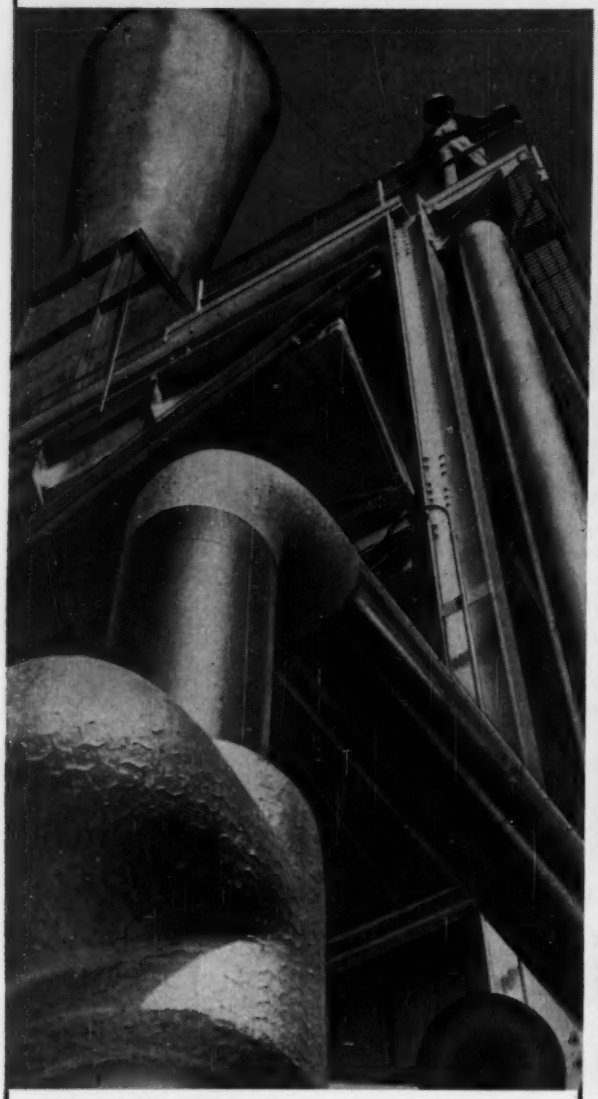
City:_____ Zone:_____ State:_____

ARMCO STEEL CORPORATION 1345 CURTIS STREET, MIDDLETOWN, OHIO

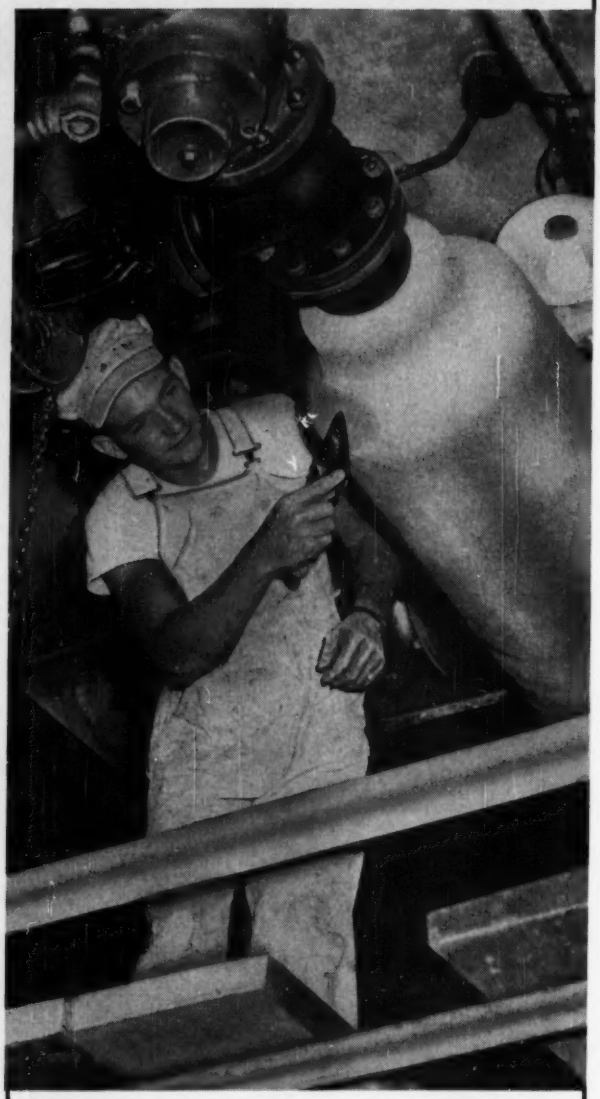
SPECIAL STEELS

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • ARMCO INTERNATIONAL CORPORATION

FOR EFFICIENT CONTROL OF RISING INDUSTRIAL TEMPERATURES



KAYLO—*King of high temperature insulations*



FIBERGLAS—*World's leading industrial insulation*

Together they answer all your insulation needs!

Average temperatures of industrial processes have increased to 500-700° F. from 350-500° in the past several years. Indications are that they'll go even higher in the future.

With Fiberglas* and Kaylo® Insulations, present and future temperatures can be efficiently controlled without adding undue bulk or cost. Both products have exceptionally low "k" factors. They're strong . . . moisture-resistant . . . stable . . . easy to apply . . . cover the entire range from lowest sub-zero to 1200° F.

Kaylo is now distributed by Owens-Corning Fiberglas Corporation, and is available in quantity. For full technical data on Fiberglas and Kaylo, see Sweet's File, Chemical Engineering Catalog, or Refinery Catalog. Or write: Owens-Corning Fiberglas Corporation, Dept. 97-G, Toledo 1, Ohio.

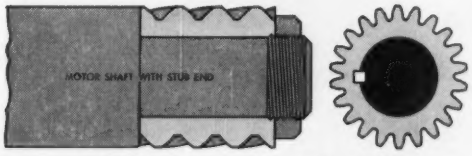
OWENS-CORNING
FIBERGLAS

*T.M. Reg. Owens-Corning Fiberglas Corporation
® Kaylo is mfd. by Owens-Illinois Glass Co., Inc.

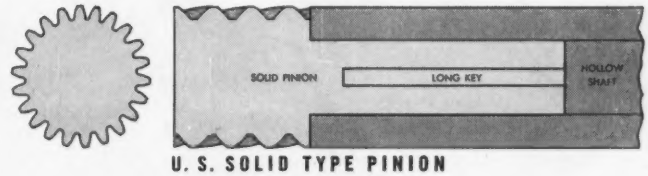
In your opinion, which pinion?

. . . for longest life in a gearmotor





ORDINARY SHELL TYPE PINION



U. S. SOLID TYPE PINION

In an internally geared motor the pinion on the motor shaft is the vital link between motor and gearing. It's the fastest, but smallest gear, so it must be extra strong, free from vibration and forever tight. Now compare the U. S. Syncrogear motor pinion with the ordinary type. Note the extra large section area of the U. S. design. It has a long solid shank that anchors into the motor's hollow shaft, whereas the ordinary shell type has a small section area, short keyed.

Obviously the U. S. design is most substantial, longer lasting, more resistant to deflection and can carry high speed loads far more safely than common designs. All the gears are deep-hardened and shaved to exact tolerances in the U. S. plants.

Added life lengthening features

The rugged pyramidal case supports the motor and gear train and all castings are normalized to insure permanent alignment and to prevent distortion. The motor windings are asbestos-protected to avoid carbonization and guard against burnouts. All moving parts are completely enclosed for weather and dust protection and confined within the least cubical dimensions on a single mounting. ¼ to 30 h.p.; 10 to 10,000 r.p.m.

U. S. Electrical Motors Inc.
Box 2058, Los Angeles 54, Calif. or Milford, Conn.

NAME_____

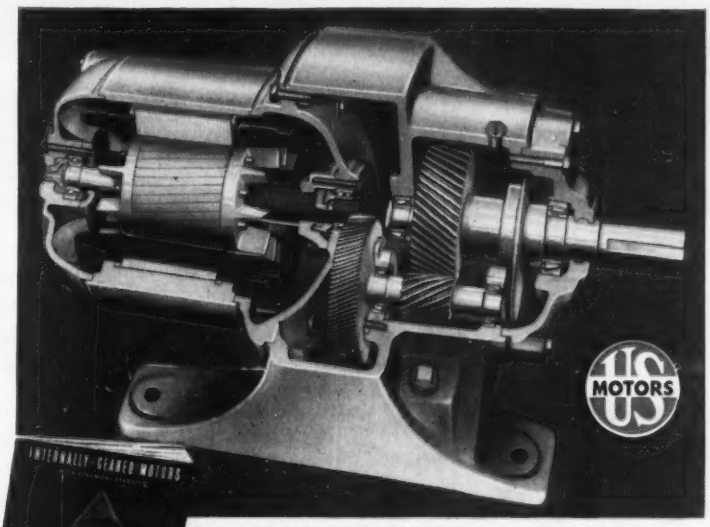
COMPANY_____

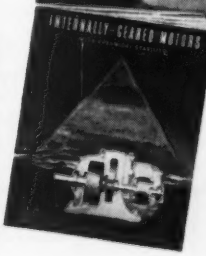
ADDRESS_____

CITY_____ ZONE____ STATE_____

THE ONLY MOTOR WITH A BUILT-IN PINION

U. S. SYNCROGEAR





FREE 16-PAGE DESCRIPTIVE BOOKLET GIVES ALL THE FACTS

Interesting multi-colored Booklet presents engineering facts you should know about geared motors, and illustrates the various U. S. Syncrogear types. Mail the Coupon for a copy. No obligation.

U. S. ELECTRICAL MOTORS Inc.

Los Angeles 54, Calif. **Milford, Conn.**

EXON: each resin engineered for a specific problem



EXON 402-A

specifically to wipe out

corrosion



*Valve molded by STOKES MOLDED PRODUCTS, Trenton, New Jersey

Millions of dollars are saved every year by American industry as unplasticized rigid PVC made from EXON 402-A wipes out corrosion. It has outstanding resistance to alkalis, acids, inorganic salts, and other corrosive fluids.

It outperforms, yet costs less than customary metals in many industrial applications. A tremendously important application, pictured above, is the new LUNCOR VALVE* engineered by The Lunkenheimer Co. It is the first all-molded PVC valve designed by a valve manufacturer.

Easier and less expensive to work with, unplasticized PVC made from EXON 402-A is strong but extremely lightweight compared with most metals. EXON 402-A is unusually versatile. It can be made into sheets, rods, tubes and other structural shapes. These can be cemented or welded... and are readily sawed, sheared, stamped, milled, drilled, planed and rolled on conventional metal or woodworking equipment.

For complete information or technical service on EXON resins, call or write Firestone.

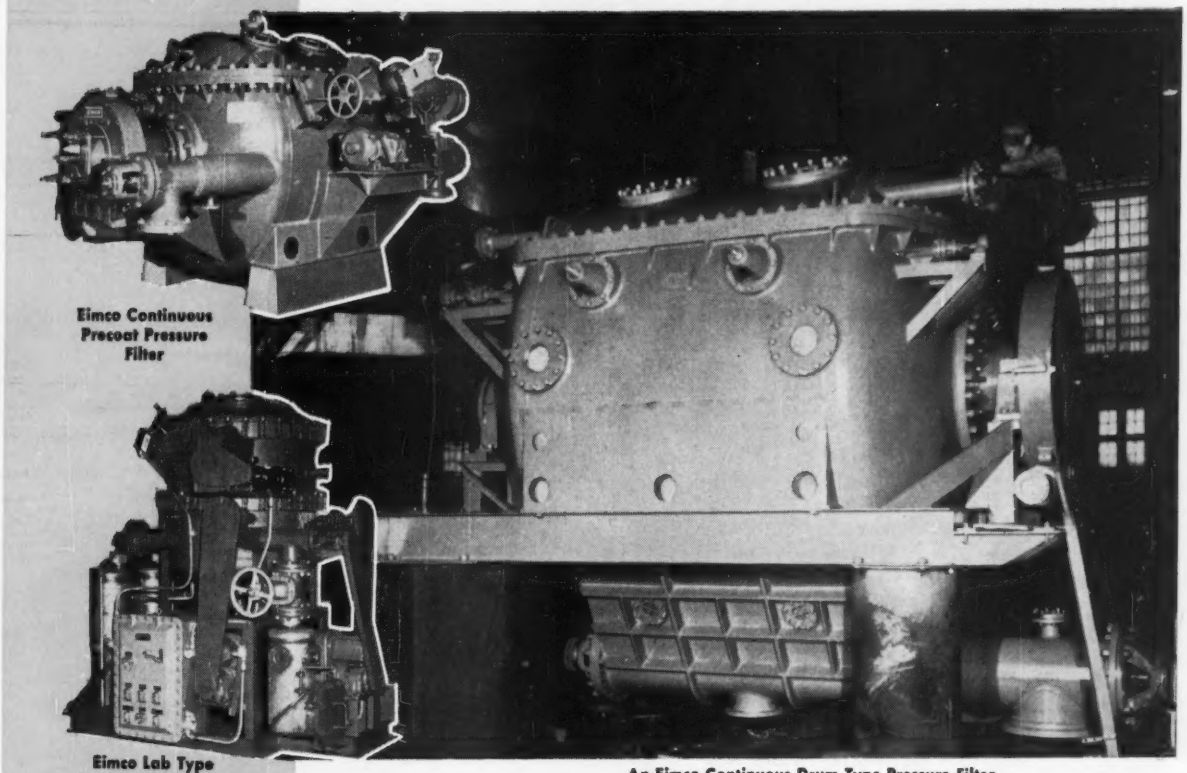
Firestone

EXON®

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA., DEPT. 28R

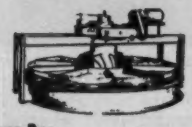
DIVISION OF FIRESTONE TIRE & RUBBER CO.



Eimco Continuous Precoat Pressure Filter

Eimco Lab Type Continuous Pressure Precoat Drum

An Eimco Continuous Drum Type Pressure Filter



Eimco Pan Filter



Eimco Pressure Roll Filter



Eimco Bi-Carb Filter



Eimco Agidisc Filter

Continuous Pressure Filtration

offers a means of solving difficult process problems which have heretofore been unanswerable.

These filters are offered only after the problem has been studied by Eimco's Research and Development Division and each filter station is then designed and constructed to handle each user's problem on an assured result basis.

Pilot plant operations are conducted on proportional sized filtration equipment of all types in Eimco's Research and Development Center or in the customer's own plant.

Successful production size installations based on findings made by Eimco's Research and Development Division prove the value of starting new flow sheets through this thorough and exhaustive method of testing to obtain all the facts.

Let us tell you more about Research in liquids-solids separation through filtration.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-126

New Ethylbenzene Plant—straddles a salt marsh!





The Williams Plant at Port Arthur, Texas. This Ethylbenzene Plant was built on a salt marsh by Koppers Engineering and Construction Division.

NORMALLY, land that is under water isn't a good place for a plant site. Yet, at Port Arthur, Texas, there was a stretch of salt marsh that was ideal in every other respect.

So Koppers engineers were called into consultation. They were asked: "Could you possibly build a chemical plant on this swamp?" They *could* . . . and did.

The land was drained. Roads were built. Structures were supported on deep-driven pressure-creosoted wood piles (Even the smallest pump was placed on piles!)

Now, on land that was formerly useless, the Williams Plant is producing high-purity Ethylbenzene, proving that the best engineering skill can overcome the worst obstacles.

Put your design and construction problems—conventional or otherwise—in the capable hands of our engineering staff. Your inquiry is invited.

KOPPERS COMPANY, INC.

Engineering and Construction Division
Chemical and Gas Dept.
Pittsburgh 19, Pennsylvania

You get more than a cutter at

SPROUT-WALDRON

You get many *plus* values when you deal with Sprout-Waldron. In cutters and other size reduction equipment, you get a wide choice of styles and sizes. And each model can be tailored to fit your needs by Sprout-Waldron's unusual "adaptioneering" methods.

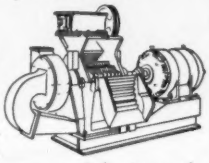


Ray Whitcomb

You also get reliable guidance on installations and applications from our engineering representatives and engineering staff. Their recommendations are based on long experience and backed by case history files of successful processing applications and laboratory tests.

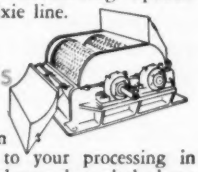
A typical Sprout-Waldron sales engineer is Ray Whitcomb, pictured here. Before coming to Sprout-Waldron five years ago, Ray sold mixing, size reduction, and materials handling equipment for two smaller manufacturers of processing equipment. His ability to analyze difficult processing problems and to suggest solutions has made him valuable to the customers he serves. With such men to help you, you're bound to buy *right* at Sprout-Waldron.

HAMMER MILLS



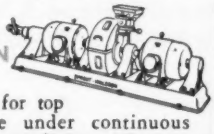
With the recent acquisition of the patents and facilities of Dixie Machinery Company, one of the finest hammer mill plants in the U. S., Sprout-Waldron now offers a line of great diversity and high quality. Before buying *any* hammer mill, check the outstanding Sprout-Waldron-Dixie line.

CRUSHERS



Crushing can be applied to your processing in many unusual ways through the large and versatile line of Sprout-Waldron sawtooth, rotary, and conical crushers. Ask how these can be "adaptioneered" to meet your specific needs and improve the quality of your end products.

ATTRITION MILLS



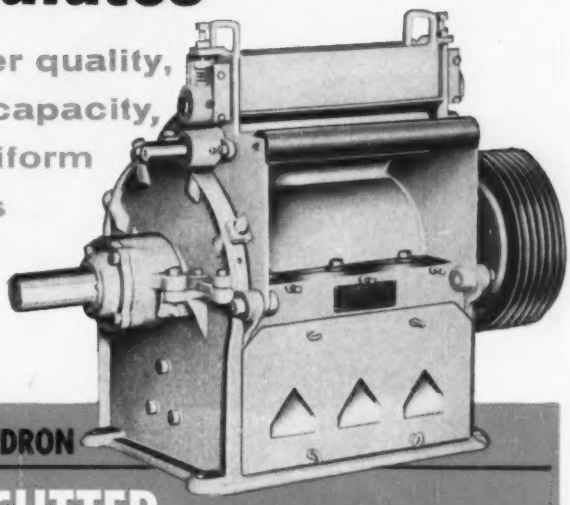
Long noted for top performance under continuous heavy-duty conditions, Sprout-Waldron attrition mills may solve your problems of rubbing, cutting, crushing, or tearing. Available with horsepowers ranging from 3 to 500 and a selection of hundreds of different disc-surface designs. Ask for details.

ALSO Sprout-Waldron offers complete lines of roller mills and burr stone mills to help solve your size reduction problems.

SPROUT · WALDRON

Cuts...Flocks... Granulates

for higher quality, greater capacity, more uniform products



SPROUT-WALDRON

KNIFE CUTTER ...with optional feed rolls

A unique arrangement of knives and screens produces clean, uniform product particles and greater capacity with a reduction in customary frictional heat. Great versatility is obtained by varying the feed arrangements, rotor types, knife clearances, and screen perforations.

The Sprout-Waldron PC-103 Knife Cutter performs such widely different jobs as pre-cutting rags or leather for subsequent defiberizing . . . flocking continuous strips of alpha pulp . . . and granulating cork or thermoplastic stock.

It can be adapted to meet individual needs through Sprout-Waldron "adaptioneering" methods. Write for full details.



FLOCK: 60 mesh flock from sulphite pulp sheet.



GEON PLASTIC: 5-20 mesh granules from 1/8" sheet cut through 5/16" screen.



LEATHER: Leather scrap through ½" screen.

SPROUT-WALDRON

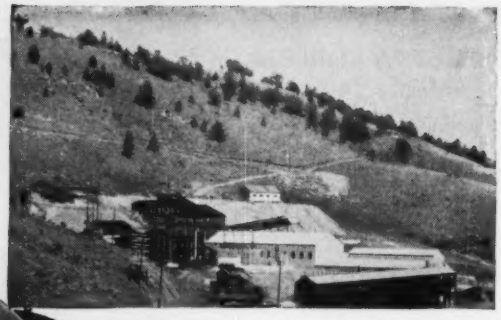
Manufacturing Engineers Since 1866

15 LOGAN STREET • MUNCY, PA.

Equipment for { SIZE REDUCTION, MIXING & BLENDING, PELLETING & CUBING, BULK MATERIALS HANDLING, PRODUCT CLASSIFICATION

***Facilities for* fabricating, machining, custom founding, woodworking, laboratory testing**

393



Exterior view of Ozark Mahoning Plant

STANDARD-HERSEY countercurrent rotary concentrate dryer

FLUORSPAR CONCENTRATE DRIED TO ALMOST 0% MOISTURE BY A

STANDARD HERSEY ROTARY DRYER

The Northgate, Colorado plant of Ozark Mahoning Co. produces Acid Grade Fluorspar exclusively. Since their flotation concentrator went into production in October of 1952, output has increased to the point where their Standard-Hersey dryer *is now operating at 150% rated capacity.*

The filter cake, produced in Denver equipment, is transported by screw conveyer to a stacking belt for stock piling and sampling, or directly into the 6′ by 50′ Standard-Hersey countercurrent rotary dryer. Moisture in the concentrate is reduced by the dryer from 12-14% to approximately 0% for shipment.

The dryer is lined throughout its length with refractories, as is the dryer furnace. Exhaust gasses at 350°F. pass through a cyclone type dry dust collection system with a balanced airlock arrangement. The temperature of the discharge product is 450°F. Semi-automatic burner controls provide efficient operation of the dryer unit.

The unusually large diameter of the dryer was selected to minimize the velocity of the gas stream through the dryer thus reducing concentrate dust loss to an estimated 1-ton of concentrate per 24 hours.

The engineering staff of the 52 year old Standard Steel Corporation has thousands of successful dryer applications to draw on in solving your problems. Over 30 types of dryers are available to fill almost every drying need in the chemical and food fields.

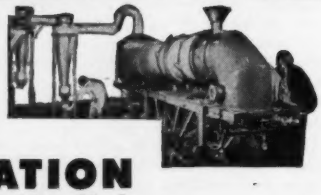
SEND FOR FREE 12-PAGE ILLUSTRATED BULLETIN

Learn how STANDARD-HERSEY has aided manufacturers throughout the world in solving their dryer problems.



COMPLETE PILOT PLANT TAKES GUESSWORK OUT OF DRYING

STANDARD-HERSEY'S pilot dryers play an important part in solving your drying problems *before* blueprint stage.

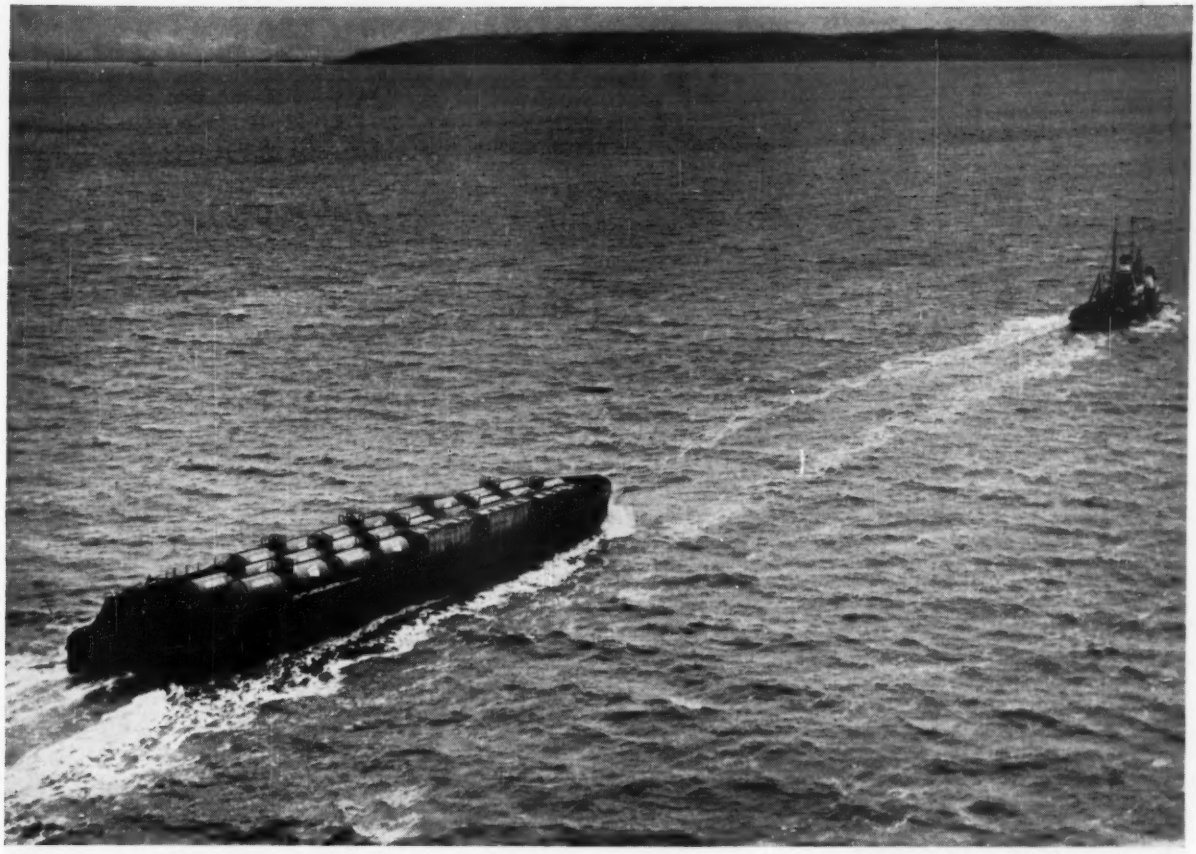


THE STANDARD FOR 52 YEARS

STANDARD STEEL CORPORATION

5005 Boyle Avenue, Los Angeles 58 • 15 Park Row, New York

DF-3



ECONOMY-SIZE PACKAGE. Chartered barge, one of a fleet used in Hooker West Coast service, carries 11 cars of liquid chlorine and other chemicals on deck. Below deck are carried, 1,000 tons of caustic soda. The barge is seen here in Elliott Bay off Seattle, en route to a pulp mill in British Columbia.

Could chemicals-by-barge save you $72,000 a year?

Tests may show that there's little brand difference in some of the heavy chemicals you buy. But there can be a real dollars-and-cents difference.

Often, *how you get them* makes that difference.

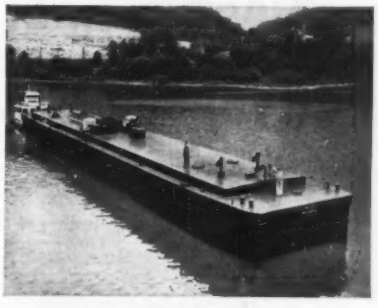
For example, a large midwestern processor had been buying 50% liquid caustic soda by tank car. At our recommendation this company decided to receive caustic by barge. The result: a $72,000-a-year saving.

If you can take caustic soda by water, why not look into barge delivery? All Hooker plants and caustic terminals, are located on deep water. There's a good chance that delivery by barge, specially chartered or Hooker-operated, can pile up real savings for you.

Call the nearest Hooker sales office or write us for more information on the dollars-and-cents difference the right method and volume of delivery can make for you.

SALES OFFICES:

NEW YORK	MUrray Hill 2-2500
CHICAGO	CEntral 6-1311
NIAGARA FALLS	6655
TACOMA	BRoadway 1215
LOS ANGELES	TErminal 4-2411
	or NEvada 6-3826



MIDWEST CUSTOMERS near Great Lakes get rapid service from Montague, Mich., or from Chicago. Two men can unload a 300-ton shipment of caustic soda from this specially-built Hooker barge in one fast, smooth operation.

5-973

HOOKER CHEMICALS

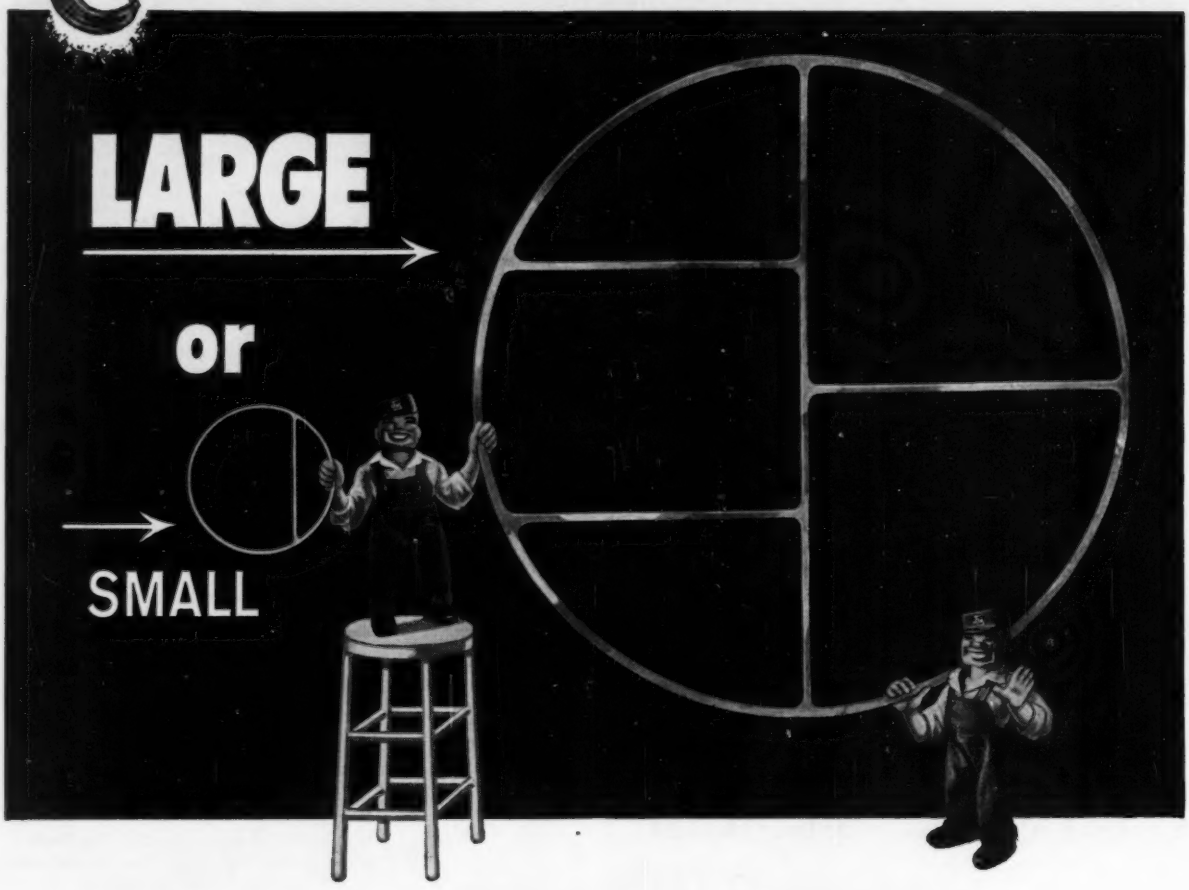
1905—Half a Century of Chemicals
From the Salt of the Earth—1955

HOOKER ELECTROCHEMICAL COMPANY

5 FORTY-SEVENTH ST., NIAGARA FALLS, N. Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

Hand-tailored to any size you need...



...Goetze Heat Exchanger Gaskets are precision-made for longer service

Whether your requirements call for heat exchanger gaskets larger than 100" in diameter, or smaller than 10", you can get the exact size you want... hand-tailored to the shape you need... simply by specifying "Johns-Manville Goetze."

And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit ... to provide ample lap widths and uniform rib widths... and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 60, New York 16, New York.

Johns-Manville *Goetze* GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE



TRENTWELD
tubing gives...

*corrosion resistance

*long service life

*ease of cleaning

*product protection

in Lo-Temp Evaporator

This Mojonnier Lo-Temp Evaporator is designed to remove water from heat-sensitive liquid foods, pharmaceuticals and chemicals, at temperatures as low as 40F. Heart of the evaporator is made of nests of TRENTWELD stainless steel tubing.

TRENTWELD tubing is an ideal choice for this application. For TRENTWELD stainless tubing resists the corrosive attack of both the product itself, and the ammonia refrigerant pumped inside the tubing. And TRENTWELD stainless is inert . . . protects the product from contamination. But that's not all—TRENTWELD comes-clean with an absolute minimum of effort.

So when you have a tubing application check first with TRENT. You'll find the largest assortment of sizes and finishes in the industry . . . standard sizes from ⅛" to 40" O.D. – larger sizes on special order. And remember, TRENTWELD stainless and high alloy tubing are products of *tube mill specialists.* You can't buy better than TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

Red hot problem

ANOTHER UNUSUAL FLOW MEASUREMENT PROBLEM SOLVED BY TAYLOR INGENUITY!

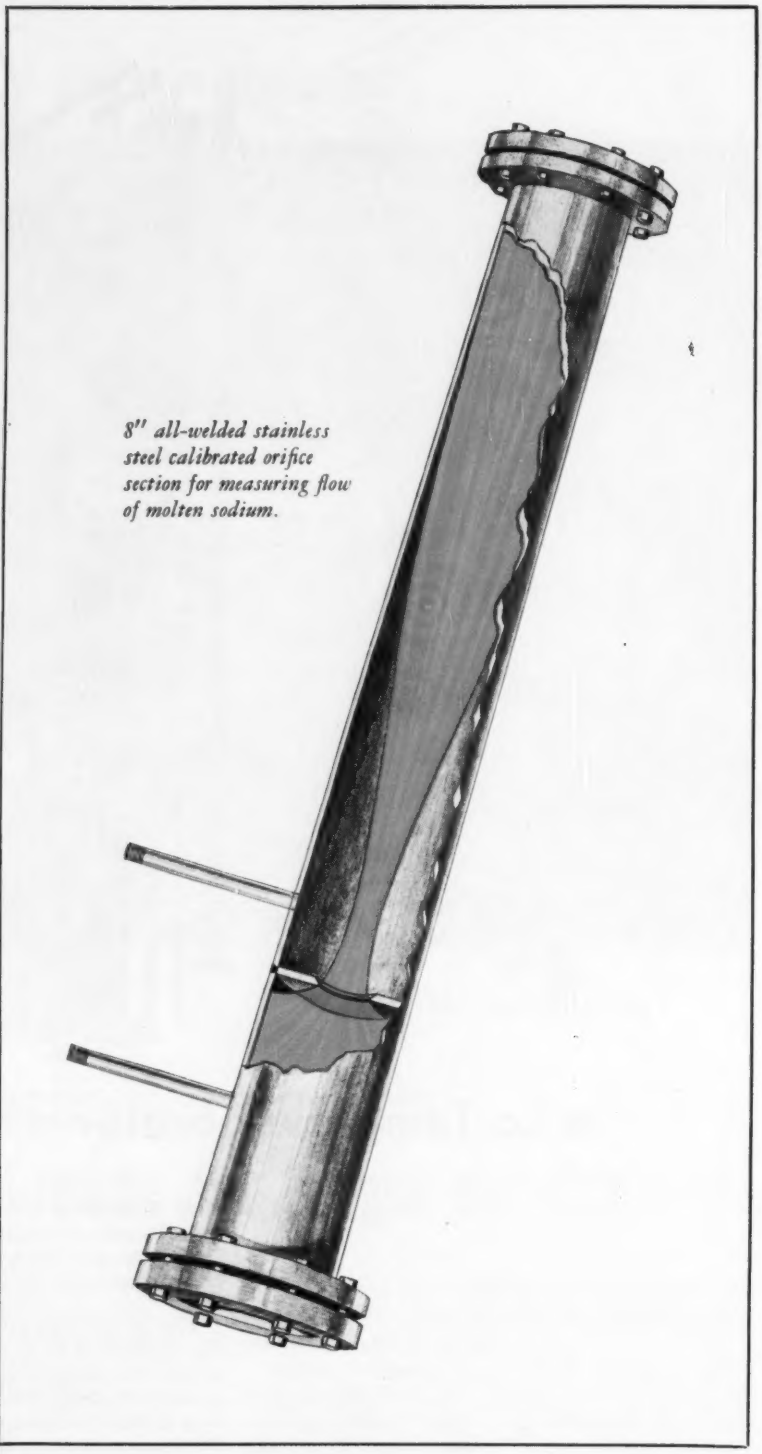
The picture shows an 8" all-welded stainless steel calibrated orifice section 24 ft. long, to be used as a primary standard. It's red hot because it measures the flow of molten sodium which is used as a heat transfer medium in an atomic energy project.

What's unusual about this? First, construction of such a large section is uncommon indeed, and immediate delivery was imperative lest it hold up an important project. Second, the calculation, design and fabrication of the primary element required highly specialized knowledge and skill. Third, certification of calibration by an independent laboratory revealed accuracy well within the specified limits.

What's *not* unusual about it? The customer brought his urgent and exacting problem to Taylor Instrument Companies for solution.

A repeat order soon after delivery is a tribute to the ingenious application engineers on the Taylor payroll. Their speed and resourcefulness in solving this out-of-the-ordinary flow measurement problem typifies the desire of everyone at Taylor to handle unusual jobs unusually well.

Probably your instrumentation problem has nothing to do with molten sodium measurement, but it's equally probable we'd have a good answer. Why not call your Taylor Field Engineer today? Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.



8" all-welded stainless steel calibrated orifice section for measuring flow of molten sodium.

Taylor Instruments

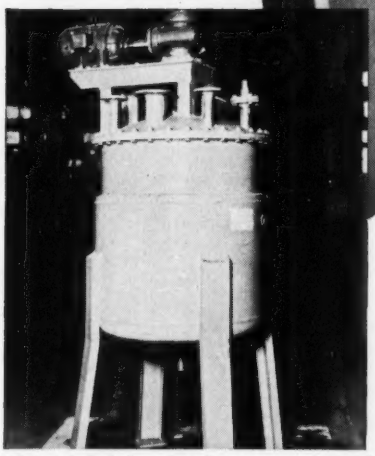
MEAN ACCURACY FIRST

INDICATING, RECORDING, CONTROLLING

TEMPERATURE, PRESSURE, FLOW, LIQUID LEVEL,

SPEED, DENSITY, LOAD AND HUMIDITY





This nickel-clad steel tank processes essential oils, was designed to operate at 100 psi. pressure.

CLAD STEEL EQUIPMENT GIVES SOLID HIGH-ALLOY PROTECTION AT LOWER COST

Where protection from corrosion, abrasion, and forms of product contamination such as metallic pick-up is a "must", clad steel equipment is often the *economical* answer. Under pressure, vacuum or thermal cyclical service, the high-alloy cladding will not tear away nor will bond failure permit liquid seepage between cladding and backing. If processes change, equipment modifications can be readily made without injuring the clad surface or bond. The smooth contours and joints possible with clad mean easy cleaning and low maintenance, too.

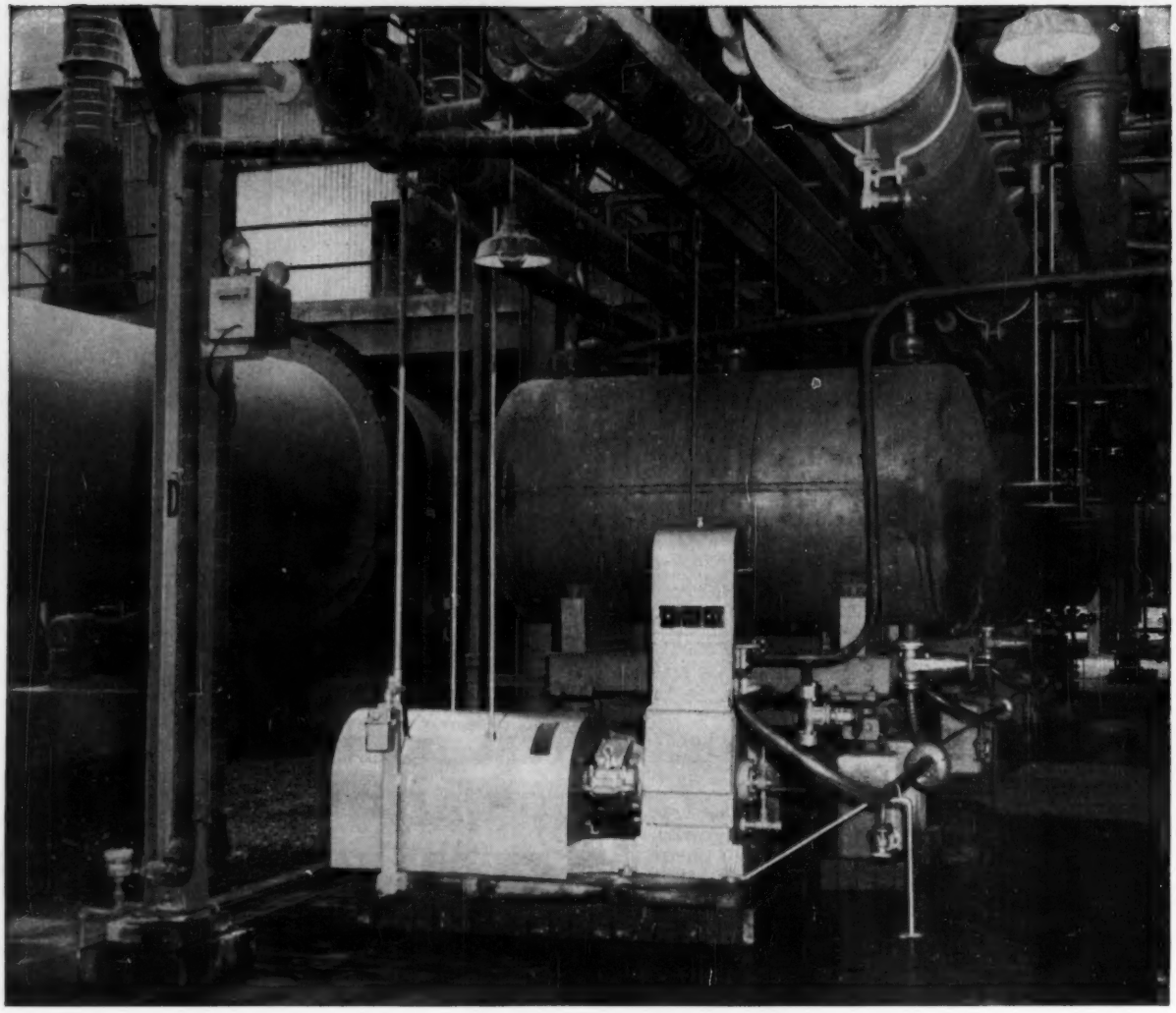
Why pay a premium for protection in your new processing equipment? Lukens Clad Steels—stainless, nickel, Monel, Inconel, copper—give you all the advantages of these solid high-alloys with savings up to 50% in material costs.

When you're thinking of new tanks and vessels, *qualified* equipment builders can assist from the earliest stages of planning. Working with your engineers and consultants, they know how to help minimize first cost and assure trouble-free equipment life with clad steel. We offer the widest range of clad steels available and work closely with fabricators to help select the type most suited to your processing needs. If you would like further information, ask one of your builders or write Manager, Marketing Service, Lukens Steel Company, 749 Lukens Building, Coatesville, Pennsylvania.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE



Another Chemical Pumping Job — handled by ALDRICH

This scene is the plant of a leading manufacturer of explosives, where the Aldrich Triplex Pump pictured in the foreground pumps nitric acid at the rate of 185 lbs. per minute against 400 psi maximum pressure.

It's one of many jobs Aldrich Pumps are called upon to do in the chemical industries. These versatile pumps are ideal wherever applications involve corrosion, abrasive materials, high viscosity or high pressure. In addition to nitric acid, among the many liquids handled by Aldrich Pumps are caustic solutions, fatty acids, acetic acid, aqua ammonia, anhydrous ammonia, as well as liquids encountered in the petroleum refining, petroleum chemical and other industries.

Several types of Aldrich Pumps are available to meet your specific needs. For automatically controlled delivery Aldrich-Groff "POWR-SAVR" Pumps can handle any free-flowing liquid at discharge pressures from 300 to 15,000 psi and are available in six sizes—from 2″ to 6″ stroke and from 5 to 125 bhp. (For information, write for Data Sheet 65.) For medium to high pressure service you may need one of the many Aldrich Constant Stroke Pumps—the Direct Flow Triplex or Multiplex Pump (Data Sheets 64, 64A, 64B).

Take advantage of our broad experience in building pumps for the chemical industry and let us make specific recommendations to meet *your* chemical needs. No matter what your problem, we welcome your inquiries or requests for literature.

The Aldrich Pump Company

3 GORDON STREET • ALLENTOWN, PENNSYLVANIA

Representatives in Principal Cities

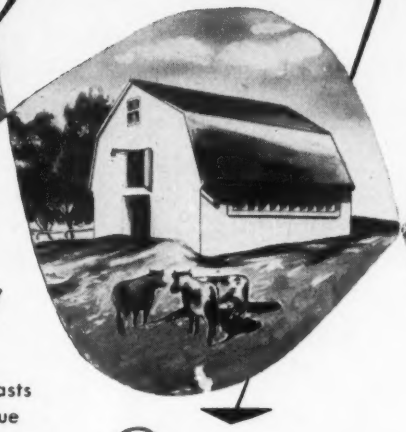
ALDRICH

...when you buy Neville Chemicals you buy *protection*



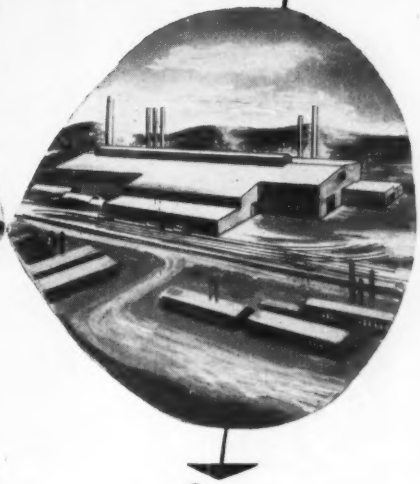
In the Home

Mastic floor tile now lasts longer and is made better due to Neville Resins. Common household items, like drain mats and bathroom mats, molded rubber products, even phonograph records, are far more durable, thanks to the use of Neville Resins. And rubber wire insulation, manufactured with these modern resins, protect the home.



On the farm

Neville Phenothiazine, used in proprietary medicines, protects cattle against disease. Neville Aromatic Solvents, used in making Insecticides and Herbicides, protect farm crops, and Neville Resins insure citrus preservation. Neville Resins also are used to make aluminum paints for farm buildings and Neville Shingle Stain Oils preserve wood surfaces.



In Industry

Coatings made from Neville Resins and Solvents protect valuable equipment, buildings and finished products from corrosion. Adhesives, floor tiles, foundry core oils, insulation compounds and rubber products—all do their job better because of Neville Resins.

Yes, when you buy Neville Chemicals, you buy *protection* . . . protection against the elements, against wear and tear, even against cattle and crop diseases . . . *protection that comes from years of experience and research in this field.*

NEVILLE CHEMICAL CO.
PITTSBURGH 25, PA.

NEVILLE

Plants at Neville Island, Pa., and Anaheim, Cal.

C7

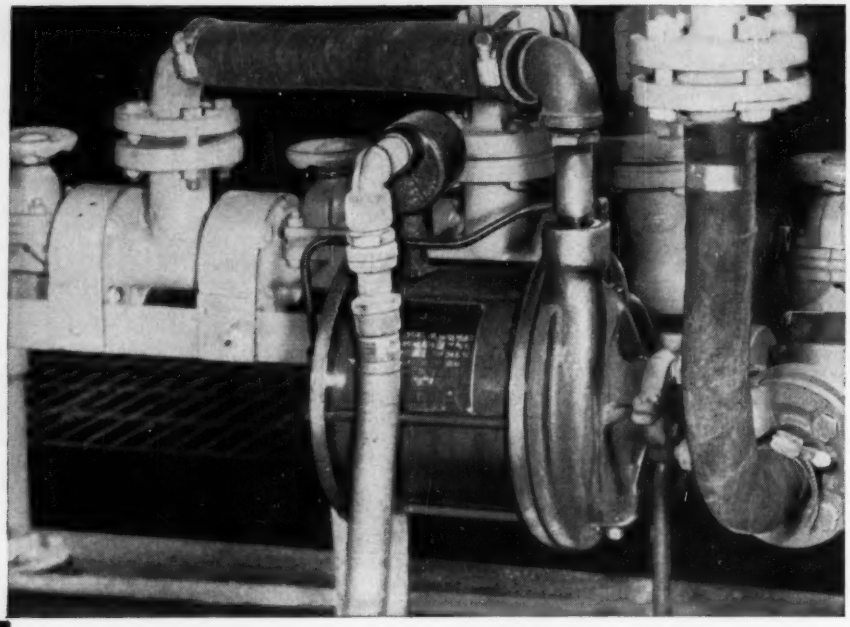
No seals

No stuffing box

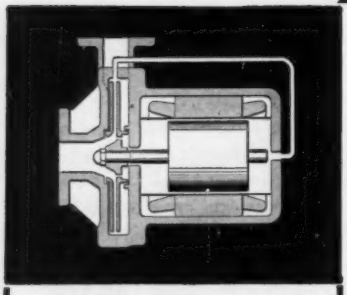
Chempump

now used in plating operations

at Western Electric Company



Leak-proof *Chempump* installed on 270-gallon plating machine at Western Electric Co.'s Allentown, Pa. plant. Seal-less unit pumps 10 gpm of solution at 155°F against a head of 35 ft.



Chempump combines pump and motor in a single hermetic unit. Pumped fluid enters rotor chamber; no shaft sealing device required.

Approved by Underwriters' Laboratories. Available in wide choice of materials . . . from ⅛ to 7½ hp. Capacities to 250 gpm. Heads to 195 feet.

Chempump can't leak!

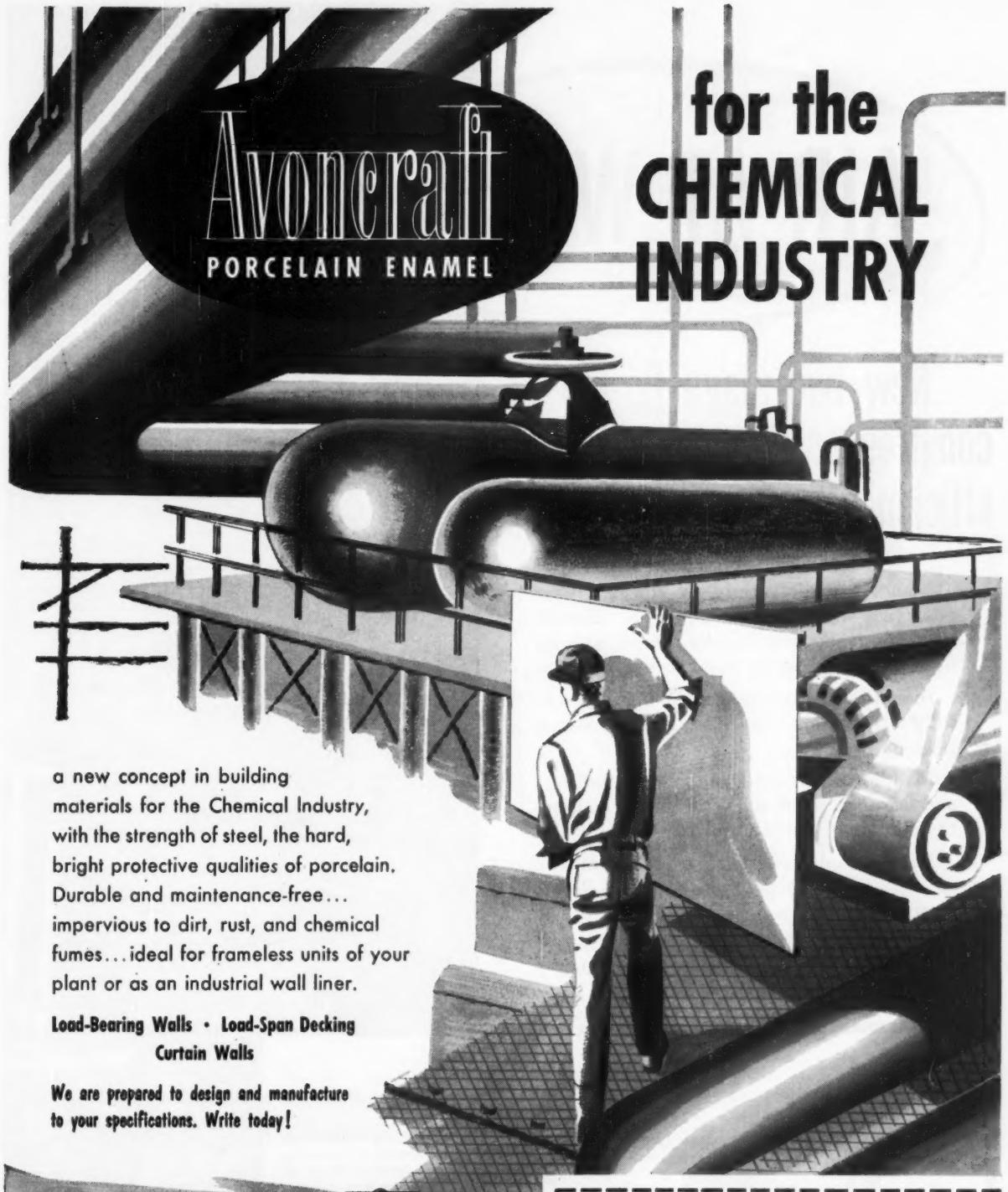
Gold plating tolerances at Western Electric's Allentown, Pa. plant are appreciably closer than in most precision plating operations. Holding these tolerances requires frequent checks on bath composition, and careful filtering and agitation of the plating solution. Selection of a leak-proof *Chempump* for this gold plating operation solves several problems. Since *Chempump* has no seals, no stuffing box, there can be no leakage of costly gold solution. Absence of any packing or other internal lubricants means complete freedom from plating solution contamination, which would seriously impair plating uniformity and product quality.

The *Chempump* runs 16 hours a day, 5 days a week. Every four months the rear bearing is replaced; the front bearing, much less often. The job takes about 20 minutes. *No other maintenance is required!*

Your process, too, can benefit with *Chempump*—the seal-less centrifugal pump that can't leak. Send for new 16 page Bulletin 1010 and get the details. Chempump Corporation, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Engineering representatives in over 30 principal cities in the United States and Canada.

***Chempump*—first in the field . . . process-proved**



for the CHEMICAL INDUSTRY

a new concept in building materials for the Chemical Industry, with the strength of steel, the hard, bright protective qualities of porcelain. Durable and maintenance-free... impervious to dirt, rust, and chemical fumes... ideal for frameless units of your plant or as an industrial wall liner.

Load-Bearing Walls • Load-Span Decking
Curtain Walls

We are prepared to design and manufacture to your specifications. Write today!

architectural products
Avoncraft

A Division of Avondale Marine Ways, Inc.
P. O. Box 1030 • New Orleans 8, U. S. A.

For further information write:
Avoncraft Div.
P. O. Box 1030
New Orleans 8, U. S. A.

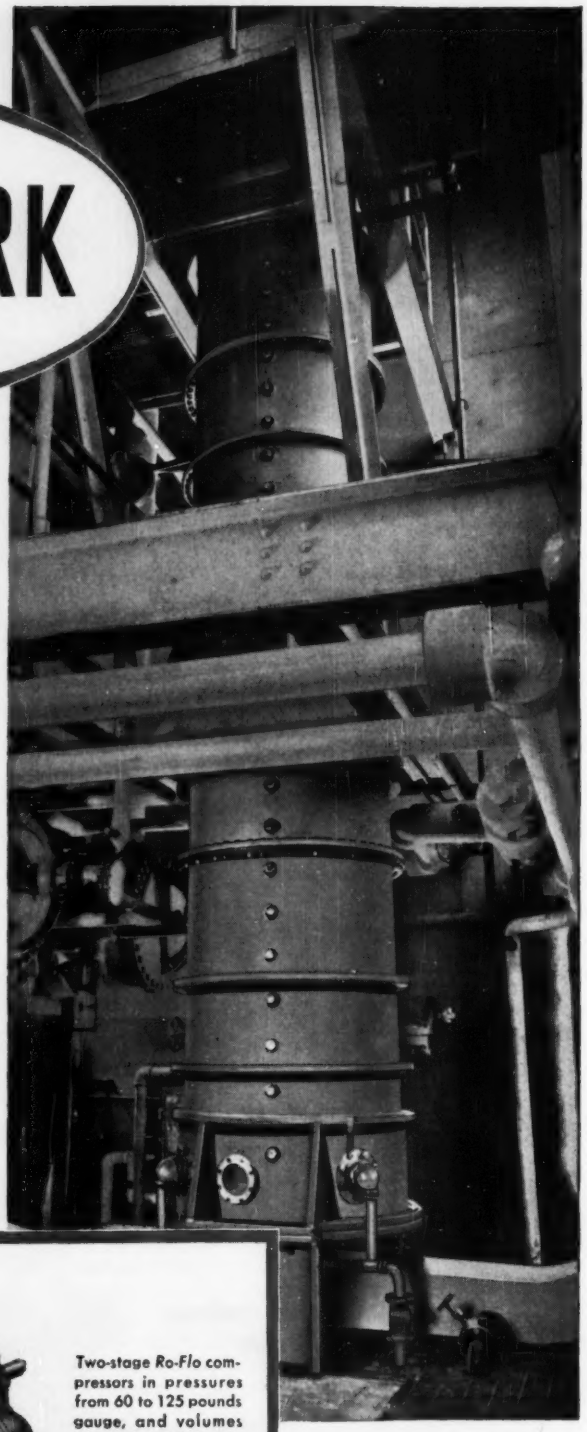
Name _____

Address _____

City _____ State _____

AIR AT WORK

New two-stage Ro-Flo compressor provides constant efficiency... cuts maintenance



Efficiency and air supply are constant year after year with *Ro-Flo* compressors. Even if wear occurs, it automatically compensates for itself so that air supply is unaffected.

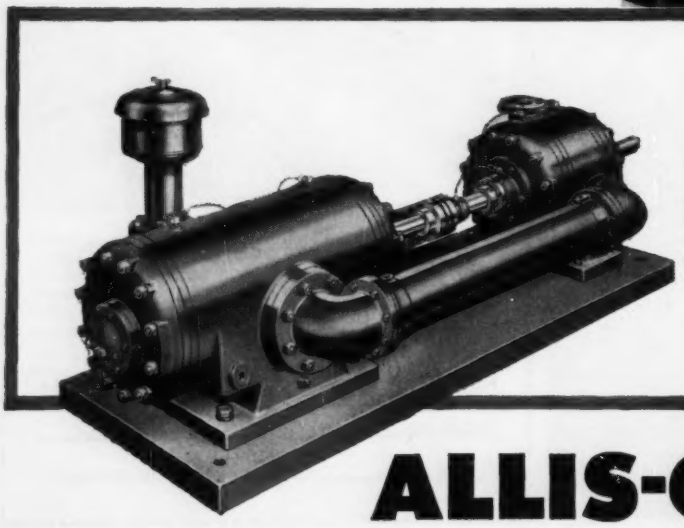
In addition, rotary design eliminates practically all vibration. No heavy foundations are needed.

Maintenance is cut too! There is no wear and tear from shock and vibration . . . no hard-to-maintain pistons and valves.

For constant efficiency . . . overall savings on air, modernize air supply with two-stage *Ro-Flo* compressors.

GET THE FACTS: Contact your A-C office or write Allis-Chalmers, Milwaukee 1, Wis.

Ro-Flo is an Allis-Chalmers trademark.



Two-stage *Ro-Flo* compressors in pressures from 60 to 125 pounds gauge, and volumes from 250 to 1800 cubic feet per minute. Single-stage units for lower pressures.

A-C ALLIS-CHALMERS

A-4739

ALLIS-CHALMERS

ADVANTAGES FOR ALKYDS . . . WITH

Glycerine

500°F

420°F

EASIER COOKING . . . *whatever the temperature*

Years of actual plant experience have demonstrated that Glycerine makes cooking of alkyd resins easier. Danger of gelling in the kettle is greatly reduced—which helps prevent costly tie-ups of men and equipment. Cooking can be carried on without complications over a wider range of temperatures.

And Glycerine has other important advantages in making alkyds, too:

- Its low MW/Hydroxyl ratio makes a wide range of resin properties economically feasible.
- Its chemistry has been thoroughly evaluated. Methods are perfected and literature abundant.
- Its liquid state simplifies handling problems. There are no bags to lift, no fines.

As year after year proves . . . *nothing takes the place of Glycerine.*

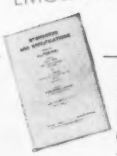
This balanced group of properties keeps **Glycerine's** usefulness growing

HYGROSCOPICITY • STABILITY • HUMECTANT •
SOLVENT POWER • VISCOSITY • NONVOLATILITY • CARRIER • SOLVENT • LUBRICANT • SOFTENER •
NONTOXICITY • TASTE • MW/HYDROXYL RATIO • EMOLLIENT • ANTI-FREEZE • ALKYD BASE •

☑ CHECK AND SEND FOR TECHNICAL DATA



☐ 20-page booklet, "Glycerine Alkyds Tailored to Need"



☐ 12-page booklet on Glycerine standards and specifications



☐ 16-page booklet on Glycerine properties and applications

For your free copy of any or all of these booklets write: **GLYCERINE PRODUCERS' ASSOCIATION** • 295 Madison Ave., New York 17, N. Y.

Allis-Chalmers presents the new

HD-11

ANOTHER BIG STEP AHEAD IN LOW-COST BULLDOZING

90 net engine hp
75 drawbar hp
20,500 lb

. . . with all the important performance advantages of Allis-Chalmers advanced basic design . . . tested and proved over millions of operating hours!

All-Steel Box-A Main Frame that soaks up shock loads, makes possible the service simplicity of unit construction.

Exclusive One-Piece Steering Clutch and Final Drive Housing with all final drive gears straddle-mounted on tapered roller bearings to insure long life.

Unit Construction lets you remove engine, master clutch, transmission, steering clutches and final drives without disturbing adjacent parts.

1,000-Hour Lubrication Intervals for roller bearing truck wheels, idlers and support rollers . . . makes production time out of service time.

Dual-Range Constant-Mesh Transmission lets you go from any forward speed to any reverse speed by shifting only one lever. Eliminates double shifting! That means faster work cycles . . . more production!

NEW STANDARDS OF PERFORMANCE AND LONG LIFE ON A WIDE RANGE OF JOBS

You owe it to yourself to investigate the performance advantages of the HD-11 . . . newest addition to the Allis-Chalmers leadership line. See your nearby Allis-Chalmers dealer now.

New Allis-Chalmers Diesel Engine with "follow-through" combustion and tornado turbulence . . . for smooth engine performance, cleaner combustion, extra long engine life.

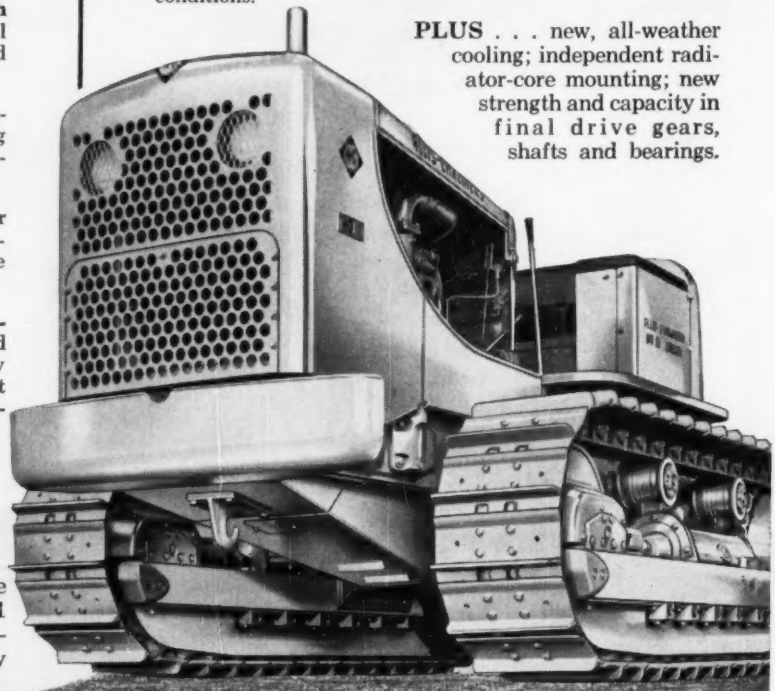
New Wrap-Around Radiator Guard used as dozer lift frame to simplify design, reduce cost of bulldozer; guard tilts forward for easy service.

New Master Clutch with Ceramic Lining sets new standards of clutch life . . . with fewer adjustments required.

New Operator Convenience including roomy, flat platform . . . foam rubber seat . . . 24-volt direct electric starting . . . 60-gal. fuel tank.

Tough New Track — New design, through-hardened with extra toughness for long life even in severe abrasive conditions.

PLUS . . . new, all-weather cooling; independent radiator-core mounting; new strength and capacity in final drive gears, shafts and bearings.



ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.



this
little drip
costs you money!

On a 10¢-per-gallon product, 6 CC of leakage per minute costs you about $90 per year in unnecessary product waste.

REPLACE
PUMP PACKING WITH

BJ
mechanical seals

Eliminate unnecessary stuffingbox leakage by installing a BJ Mechanical Seal. You not only realize important savings of pumped products but you also save on repacking and downtime losses. A BJ Mechanical Seal also prevents contamination of the pumped liquid ... protects against volatile and corrosive liquid hazards.



BJ MAKES
A COMPLETE LINE
OF MECHANICAL SEALS...

BJ makes reliable high-precision seals in material and construction combinations to answer almost any pressure, temperature and liquid requirements. This means that BJ can provide the *one best seal* for each specific pumping need. Ask your nearest BJ sales engineer to show you how Mechanical Seals can save you money. Or you can obtain further information by writing for BJ Bulletin No. 54-1-10,000.

BJ
SINCE 1872

Byron Jackson Co.
PUMP DIVISION
P. O. BOX 2017 TERMINAL ANNEX • LOS ANGELES 54, CALIF.
Sales Offices in Principal Cities

UNICHROME
Trade Mark

News about
COATINGS for METALS
Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Two new corrosion-blocking materials join UCILON Coating Systems

Sprayable plastisol gives extra thick film in one coat

Unichrome Coating 5300 makes the spraying of vinyl plastisols a practical and easy matter. It's the first plastisol that can be successfully used even on a cold vertical metal surface, if that surface can be uniformly baked afterwards. No longer need these thick resinous materials be restricted to metal equipment of dippable size.

Coating 5300 builds a protective film 20 mils thick in one coat, or thicker in multiple coats. Multiple coats can often do many of the jobs for which sheet materials are used, such as tank lining. Coating 5300 assures protection free from pores or seams, and with the inertness of vinyls to a broad range of chemicals and corrosives.

Bulletin VP-1 gives more information — send for it.

Internal protection for steel drums

The requirements for a lining material for steel drums are clear cut. The lining has to prevent corrosion, prevent contamination, withstand constant contact with the product being packaged and have the right physical properties for this rough and tumble service.

By applying its knowledge of protective coatings, United Chromium has developed many types of linings to meet the needs of a tremendous variety of processed products. Unichrome vinyl, phenolic, plastisol and epoxy formulations can handle most jobs economically and reliably.

UNITED CHROMIUM DIV.
METAL & THERMIT CORPORATION
100 East 42nd Street, New York 17, N. Y.
Waterbury 20, Conn. • Detroit 20, Mich.
Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto 1, Ont.



Ucilon Coating 1901, 1951 and 458 add advantages of neoprene base materials and vinyl-Thiokol compound to available Ucilon Coatings—some of which are shown here.

Virtually all successful chemical resistant coatings now represented in the group . . . one of the widest available

Neoprene coating systems and a special modified vinyl system have joined up with the 16 other Ucilon* Coating Systems that stop hundreds of severe corrosives.

Nineteen specialized Ucilon protective coating systems now available give engineers a formidable arsenal with which to combat corrosion. The wide array permits a choice of system best suited to the corrosive, to the service conditions, to the type of equipment or structure to be protected.

HEAVY FILMS WITH FEW COATS

Ucilon Coating 1901 is the air-drying neoprene material designed for general maintenance against corrosive *fumes*. It gives a 6½ mil film in 3 coats. Ucilon Coating 1951, in the same neoprene group, offers a catalyzed topcoat for protection against corrosive *solutions*.

COMBINATION OF CHEMICAL RESISTANCES

A system based on newly formulated Ucilon 458 combines the advantages of both vinyl and Thiokol materials. The coating has a broadened range of applicability, giving a thick film that resists strong chemicals as well as petroleum derivatives.

FOR THE TOUGH MAINTENANCE PROBLEMS

In the large group of Ucilon Protective Coating Systems, engineers can now get the protection required from a choice of practically every successful corrosion controlling coating — including vinyls, vinyl-Thiokols, neoprenes, chlorinated rubber, phenolic and fish oil type coatings. There are proved, economical coatings for acids, alkalies, other strong chemicals, salt solutions, oils, wetting agents and more. Bulletin MC-9 gives details. Send for copy.

*Trade Mark

B&G HEAT EXCHANGERS
...FOR EVERY TYPE OF SERVICE!



TYPE "OC" STRAIGHT TUBES

Sound design, plus precision manufacture, assure efficient operation. Removable tube bundle easily cleaned inside and out. Minimum free annular area and baffles with close tolerances reduce by-passing around the tube bundle. Other features include high tensile strength bolting, full thickness tube sheet and ample metal ligaments between tube holes. ASME quality at no extra cost.

TYPE "U" U-BEND TUBES

Recommended where the lower price of a single tube sheet unit is a necessary economy. These exchangers are also desirable where temperature differential across the tube bundle is extreme. Features include external gaskets, full tube bundle and close tolerance baffles for minimum by-passing. Metal ligaments between tube holes are extra large for internal strength. High tensile strength bolting. ASME quality fabrication.

FUEL OIL PRE-HEATERS

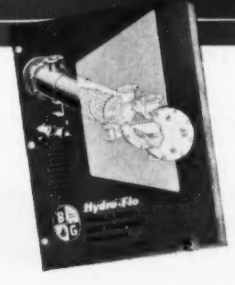
Reduce viscosity of heavy oils to permit pumping—control temperatures for proper atomizing of different oils. Units are available in straight tube and U-bend construction, for steam or water as the heating medium and with 2 to 10 passes.

GAS COOLERS

Efficient "air tube" design (air in tubes, water in shell) makes more effective use of cooling surfaces and reduces pressure drop. Cooling water is directed back and forth across tubes by baffles and moves in a direction counter to air flow.

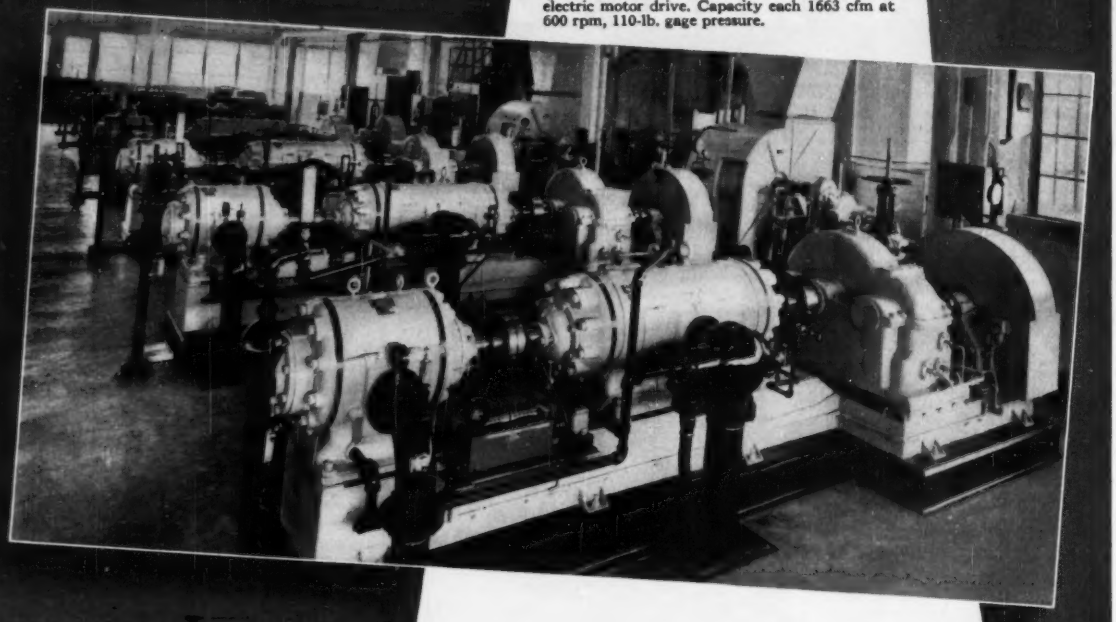
TYPE "WU" WATER HEATERS

Produce large volumes of hot water from amazingly small units. Boiler water is pumped by a B & G Booster through the shell, greatly increasing the capacity of the heater. This also permits close control of service water temperature. Because of pumped circulation, connecting pipes and fittings are reduced in size, saving material and labor. "WU" Heater is instantaneous—no tank needed.



Send for this catalog of B & G Shell and Tube Heat Exchangers and Centrifugal Pumps.

BELL & GOSSETT
COMPANY
Dept. DY-14, Morton Grove, Illinois
Canadian License: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada



Four C-300-300H Fuller Compressors, steam turbine drive. Capacity each 1248 to 1805 cfm with a corresponding speed range of 450 to 650 rpm; one 125 and three 110-lb. gage pressure. Two C-300-300H Fuller Compressors, electric motor drive. Capacity each 1663 cfm at 600 rpm, 110-lb. gage pressure.



PUTTING THE AIR IN AIRCRAFT

Aircraft companies use a lot of compressed air in the manufacture of airframes, engines, systems and components. The battery of six Fuller compressors pictured above meets one important aircraft facility's entire diversity of compressed air needs, efficiently and economically.

The key to Fuller's smoother operation is *rotary motion*, which provides large capacity in relation to size, simple direct drive from motor or internal combustion engine, minimum number of working parts, one-way air flow free from pulsation, lack of vibration, continuous service with minimum supervision and maintenance. Operation in cramped quarters or on ordinary flooring is simple and practicable.

Fuller Rotary Compressors are built for capacities to 3300 c.f.m., 125-lb. pressure. Write for Bulletin C-5A, illustrating and describing these machines.

Fuller

. . . pioneers in harnessing AIR

C-274
1776

FULLER COMPANY GENERAL AMERICAN TRADE MARK

FULLER COMPANY, Catasauqua, Pa.

GENERAL AMERICAN TRANSPORTATION CORPORATION SUBSIDIARY

Chicago • San Francisco • Los Angeles • Seattle • Birmingham

buy quality

...in a filter

buy Sparkler

...and collect cash dividends in labor savings and operating economies

This Sparkler MCR rectractable tank filter is saving $24,000.00 a year in labor alone for a large mid-west brewery. Every installation of this filter has resulted in lower cost filtering.

The retractable tank idea eliminates the time wasted in breaking pipe connections or outlet seal in opening filter. Fast manipulation with resulting labor saving is a distinctive feature of the MCR filter.

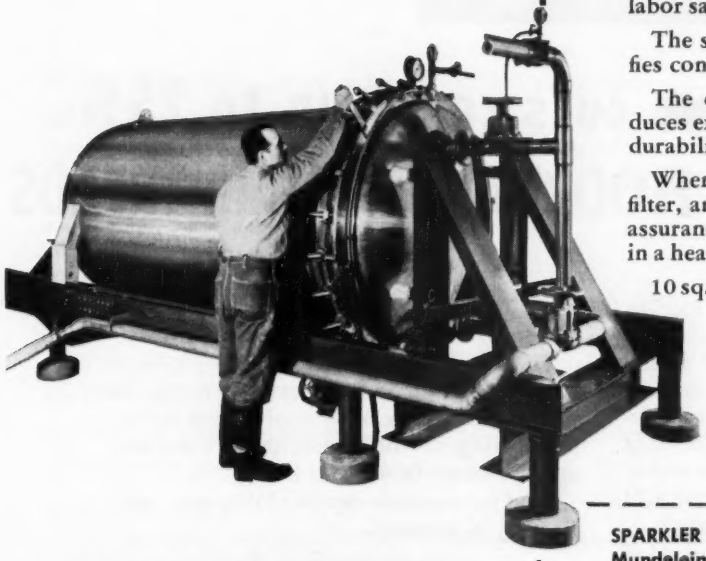
The smooth hydraulic power mechanism simplifies controls to practically a push button operation.

The exclusive Sparkler MCR plate design produces exceptionally high flow rates with unmatched durability.

When you buy a Sparkler MCR retractable tank filter, and see it operate, you have that comfortable assurance you have the best, and most economical, in a heavy duty filter.

10 sq. ft. MCR Models available for sample testing.

Mail coupon for details today
or phone at our expense.



Sparkler Manufacturing Company
Mundelein, Illinois **Phone: Mundelein 6-6430**

Manufacturing plants in Canada, Holland, Italy, Australia.
Service representatives in principal cities throughout the world.

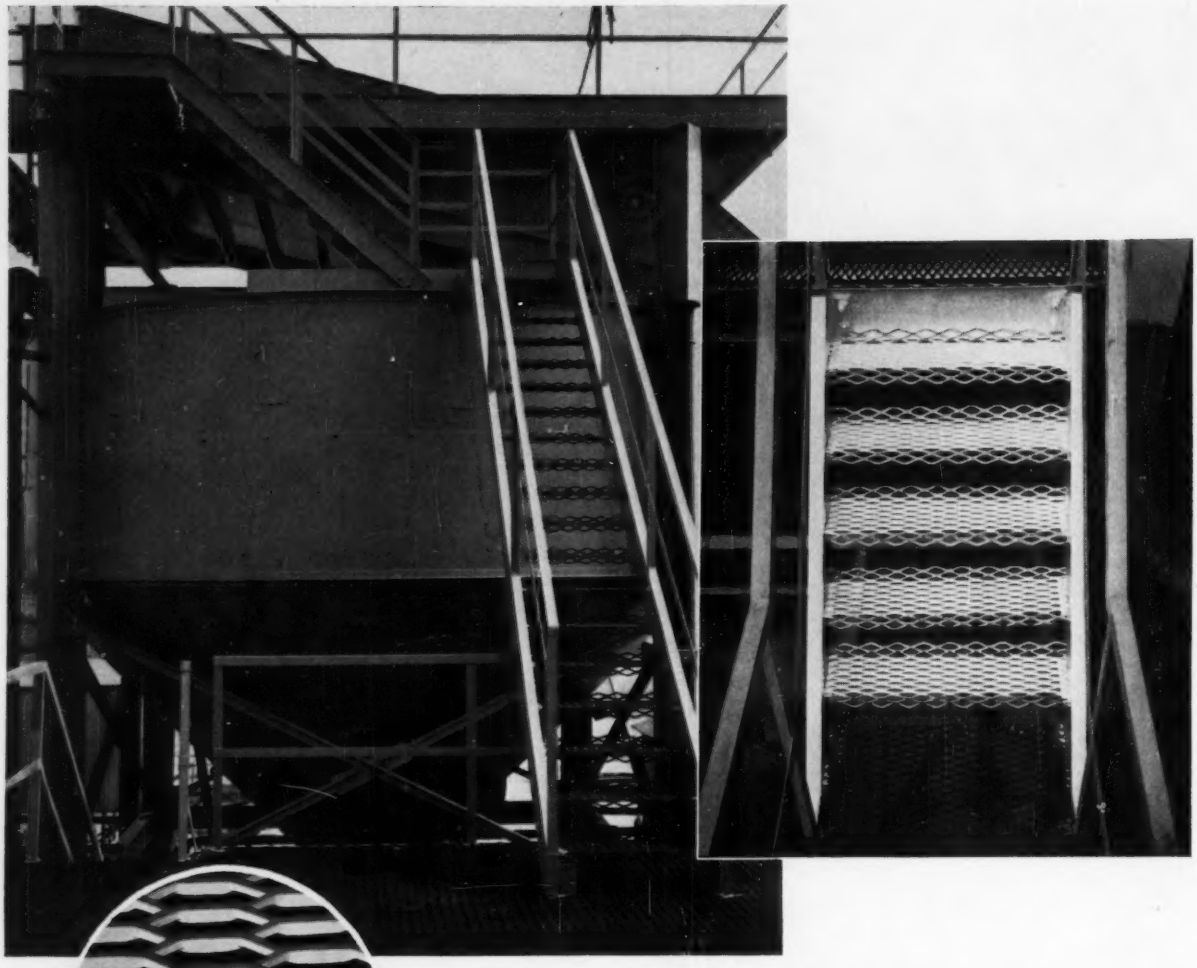
SPARKLER MANUFACTURING COMPANY
Mundelein, Illinois

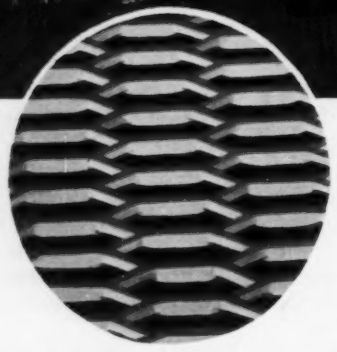
☐ Send literature on MCR retractable tank filters.
☐ Would like to see representative engineer about our filtering problem.

Individual_____

Company_____

Address_____





← cuts costs up to 25% on FLOORING and STAIR TREADS

Armour and Company, near Bartow, Florida, had a grating problem: How to provide 18,000 square feet of open steel flooring and several hundred stair treads, for structures in their new Phosphate Recovery Plant... *economically!* The flooring and treads had to be open to allow drainage of water used in the washer operations. Their solution: Penmetal 4.27 TREADWAY (expanded metal grating).

Used as flooring and stair treads instead of conventional grating, Treadway cuts costs up to 25% per square foot of floor area.

The photographs above illustrate typical sections of floor area, and the unique method used in the fabrication of the stair treads. Each tread is a single piece of Treadway turned to a 90° angle at the front and rear edges. This forms a kick plate and makes the tread even stronger. Most of the treads in this installation are 36" long and will support a 200 lb. man at mid-span, with no apparent deflection.

This rugged, economical steel grating, with slip-resisting safety inherent in its design, is practical for many other applications where safe footing, durability, fabrication costs, and appearance are factors.

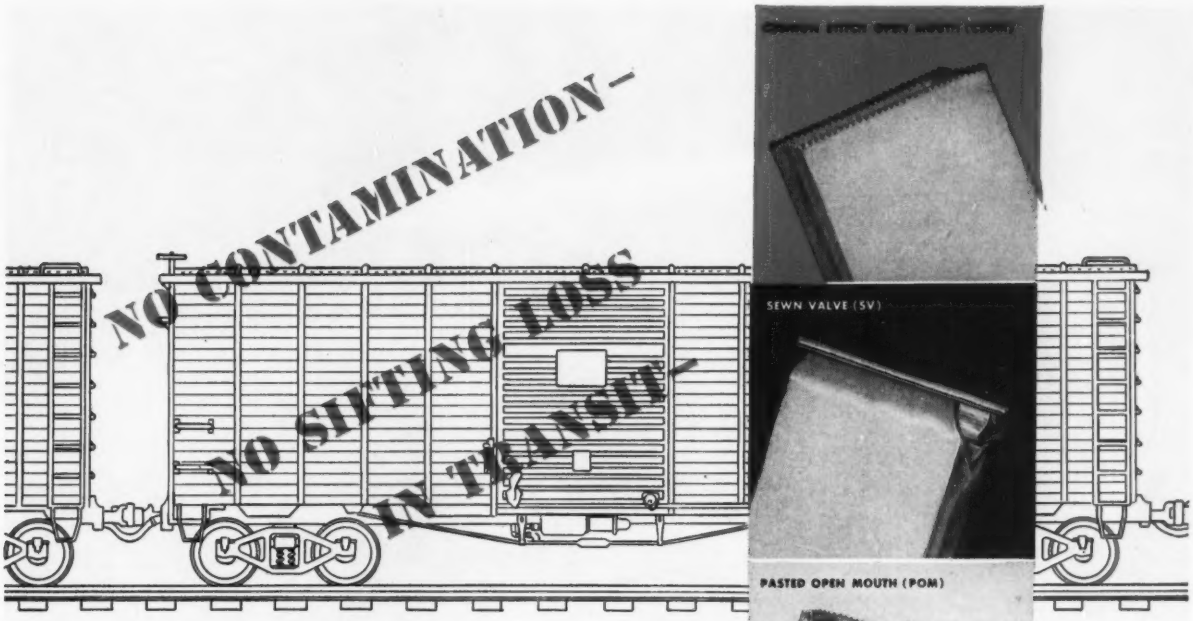
Send for complete details of this open steel flooring of economy.

PENN METAL COMPANY, INC.

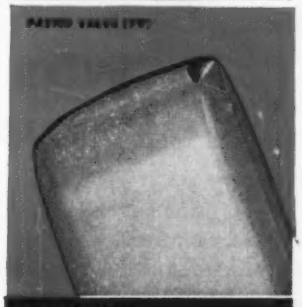
General Sales Office:
205 East 42nd Street, New York 17, N. Y.
Plant: Parkersburg, W. Va.

Penmetal

PM-73









when you bag in

BAGPAK

Multiwalls

Bagpak Multiwalls assure constant, perfect protection against loss and contamination in transit and storage. Bagpak offers five basic types of Multiwall Bags for proper packing and shipping of every type of commodity:

- *Cushion Stitch Open Mouth (CSOM)*
- *Sewn Valve (SV)*
- *Pasted Valve (PV)*
- *Pasted Open Mouth (POM)*
- *Automatic (SOS)*

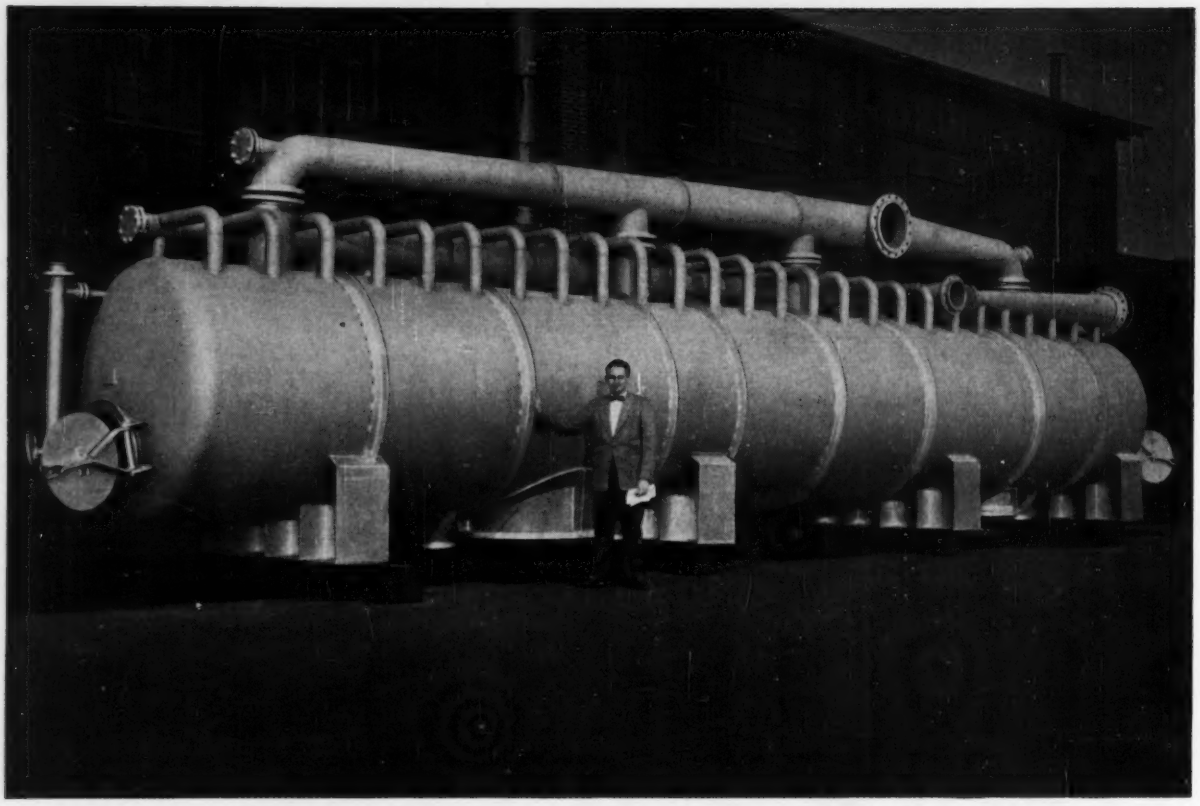
Bagpak Multiwalls are saving time and money, piling up profits for manufacturers the country over.

To find out how Bagpak Multiwalls can paint a better profit picture places you under no obligation.

Just write: K-21.
International Paper Company, Bagpak Division
220 E. 42 Street, New York 17

International Paper COMPANY
BAGPAK DIVISION

BRANCH OFFICES: Atlanta · Baltimore · Boston · Chicago · Cincinnati · Cleveland · Dallas · Denver · Des Moines · Detroit · Joplin · Kansas City, Kansas Los Angeles · Minneapolis · New Orleans · Philadelphia · Pittsburgh · St Louis · San Francisco · IN CANADA: The Continental Paper Products, Ltd., Montreal, Ottawa, Toronto



Receiver of type 304 Crucible Rezistal® stainless steel fabricated by O. G. Kelley and Company for the Rotareaed Corporation.

why it cost less to use stainless

This vessel improves the quality of paper stock. It is the receiver unit in the "Deculator" process, which removes all gasses from the wet stock in paper-making operations.

These receivers used to be made of carbon steel, lined with a phenolic resin. But the designers, The Rotareaed Corporation, wanted a material that could better withstand the highly corrosive nature of some paper stocks and the erosion that normally takes place within the receiver.

Then Crucible stainless steel, type 304, was tried. In the long run it proved to be less expensive. For stainless *fights* corrosion. Because it is almost impervious to oxidizing acids, it resists attack by corrosive paper stocks.

What's more, the erosion that used to be so costly in previous receivers has an insignificant effect on stainless. With its tough, abrasion-resisting surface, stainless often outlasts other metals scores of times in erosive or abrasive environments.

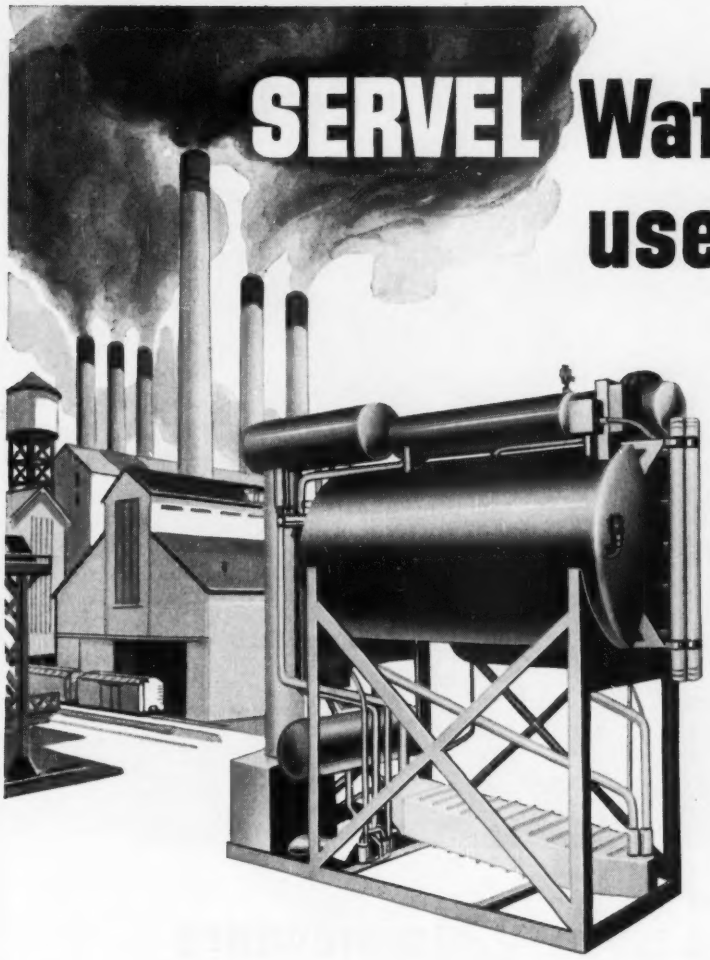
As a leading stainless steel producer, Crucible has much application and fabrication data to offer you. You'll find a great deal of this type of information in "Making the most of Stainless Steels in the Pulp and Paper Industry." Write for your free copy. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

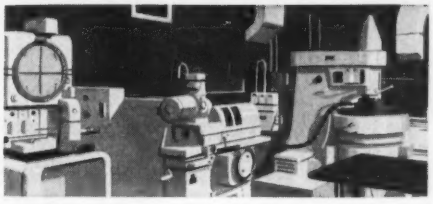
CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

SERVEL Water Chillers use waste heat

to provide low-cost chilled water





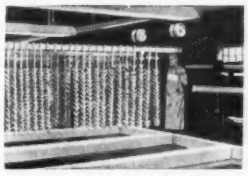
Industrial pre-cooling—Helps you increase capacity and improve performance of air compressors and internal combustion engines.

Turn waste into work and costs are bound to go down. That's just what Servel Water Chillers will do for you.

Servel's exclusive absorption principle uses waste heat (or steam) from any source to provide chilled water and at controlled temperatures. It gives you a cooling agent for air conditioning . . . or for hundreds of process applications.

These efficient units have no moving parts. Give you vibration-free operation and low upkeep. Compact size and low floor loading permit single or multiple installations in the most advantageous locations. You can locate them overhead . . . or outside of the building. What's more, you save the high cost of heavy-duty wiring.

Check these advantages against *your* cooling needs. Your Servel dealer will gladly supply details and engineering help. Or mail coupon today.



Process cooling—Here's matchless control for manufacturing and formulating processes. Regulates temperatures to precision limits.



Air conditioning—Gives you economical humidity and temperature control. Operates efficiently from cheapest fuels . . . even waste heat.

Send coupon for details, now!

Servel

the name to watch for great advances in

AIR CONDITIONING ✓ REFRIGERATION

SERVEL, INC., Dept. CE-75 Evansville 20, Indiana

Please send me specifications and full information on Servel Water Chillers.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

Carpenter Stainless Tubing Gets the Call



For Long-Life...Easy Maintenance

When job conditions are tough and maintenance costs are critical—you can follow the lead of thousands of chemical processing plants and equipment manufacturers and call for Carpenter Stainless Tubing.

The flash cooler pictured here is an example. Carpenter stainless gives the manufacturer more than corrosion resistance. It also has uniform wall thickness; tight adherence to strict physical specifications; unexcelled quality, from length to length and order to order.

It adds up to the fact that there is a cost-saving difference in stainless tubing and pipe and Carpenter makes that difference. Put this provable difference to work for you. Call Carpenter for prompt delivery and any engineering or design help you may need.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.
Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter
more than corrosion resistance
Stainless Tubing & Pipe



Greatest Advance Since Rubber-Base Paints

NO-DRIP NO-SPILL NO-SETTLE NO-STIR GEL PAINT

—Made Possible by General Mills Polyamide Resins

It's not a liquid—not a solid. The paint above is a new gel paint made thixotropic through Burnok* alkyd vehicles produced with General Mills' Polyamide Resins. This paint won't splatter up a house . . . drip down onto your hand . . . or settle during storage. It needs no drop cloths or stirring sticks.

Polyamide Resins help suspend pigment and vehicle in a jelly-like state indefinitely. There's no time-consuming stirring or straining. Friction of paint brush or roller turns the gel to a flowing liquid. This sets quickly, without sagging or beading.

Could you sell a product like that? One that makes the job easier, cleaner and faster? The zooming sales of T. F. Washburn Company's new thixotropic Burnok* vehicles say you could.

Gel paints are the newest examples in a long and remarkable list of Polyamide Resin applications. Have you a product that needs improved competitive performance? It might reward you many ways to investigate the unique characteristics of General Mills Polyamide Resins. They contribute greater impermeability, better adhesion, improved wearing qualities to a wide range of coating and covering; adhesive and laminating; and potting and casting products.

General Mills also makes a full line of Fatty Nitrogen Compounds and Fatty Acids.

SEND THIS COUPON

*Please note: BURNOK paint vehicles are patented products of the T. F. Washburn Co., Chicago, Ill. and are not offered for sale by General Mills.

PROGRESS THRU RESEARCH

General Mills **CHEMICAL DIVISION**
Kankakee, Illinois

Please send me technical information on Polyamide Resins to be used for protective coatings or for_____

Name_____

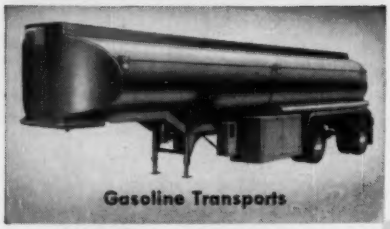
Firm_____

Address_____

City_____ Zone____ State_____

E-7-1-55

GREATEST LINE IN TANK-TRAILER HISTORY!



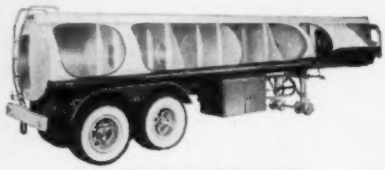
Gasoline Transports

Here are just a few Fruehauf models

Wherever, whenever, there's a liquid-hauling job to be done, there's a Fruehauf Tank-Trailer specially designed to do it *profitably!* Fruehauf's line of Tank-Trailers is the broadest, the finest, in the Trailer industry!



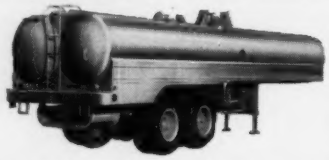
Western Truck-Full-Trailer Gasoline Combinations



A Cutaway View of the Gasoline Transport



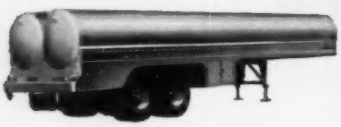
Fuel Oil Tank-Trailers



Twin-Cylinder Casinghead Transports



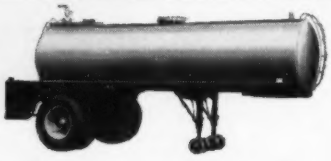
Stainless Steel Acid Transports



Twin-Cylinder Propane and Butane Trailers



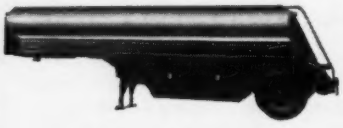
Stainless Steel Alcohol Tank-Trailers



Plastics Transports



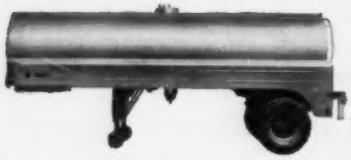
Low Pressure Hot Sulphur Trailers



Solvents Transports



Truck-Tanks



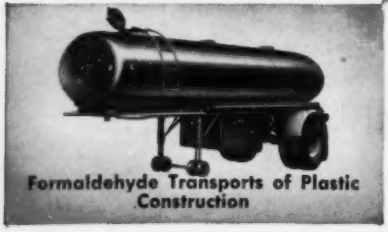
Low Pressure Latex Tank-Trailers



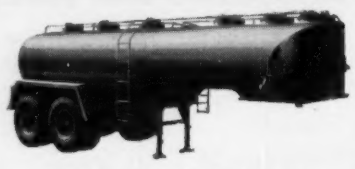
Carbon Steel Insulated Acid Trailers

FRUEHAUF TRAILERS

"ENGINEERED TRANSPORTATION"



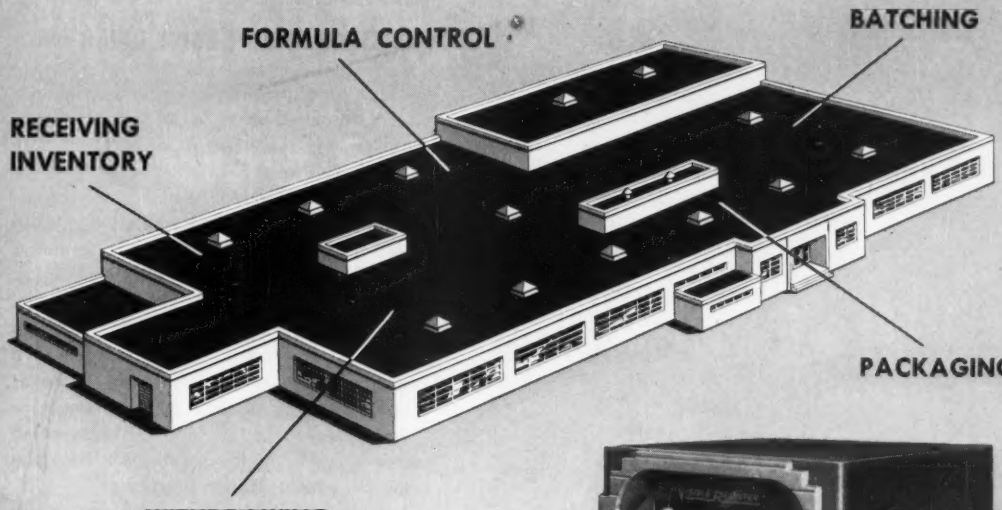
Formaldehyde Transports of Plastic Construction

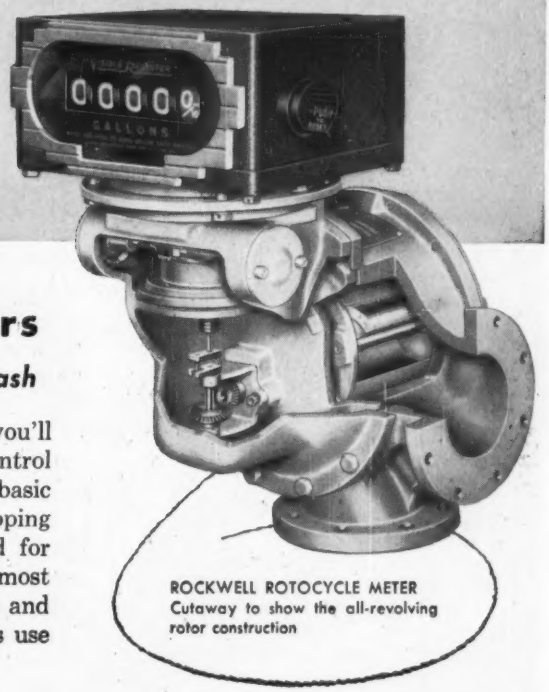


Calcium Chloride Transports

For complete information on Fruehauf's full line of Tank-Trailers, or about any specific unit for your business, call your nearest Fruehauf Branch or write to Fruehauf Trailer Company, 10969 Harper Avenue, Detroit 32, Michigan.

Accounting at Every Liquid Handling Point





ROCKWELL ROTOCYCLE METER
Cutaway to show the all-revolving rotor construction

Rockwell Industrial Meters

Guard Your Liquids as You Guard Your Cash

Put Rockwell Industrial Meters to work. Then you'll control your costs . . . control your processes . . . control your end product quality. Rockwell meters are basic accounting tools for verifying purchases, for stopping losses, for inventory and departmental control and for tax analysis purposes. They will accurately measure most any liquid that can be piped. Available in all sizes and several types for every requirement. For full details use coupon or write.

"316" Stainless Steel Meter

FOR CORROSIVE LIQUIDS

This meter, made entirely of type 316 stainless steel is the answer to many a measurement problem in the Food, Chemical, Drug and Industrial Processing fields. It resists corrosion. Made in two sizes rated at 100 and 200 gpm. Quantity control valves, strainers and a variety of registers available. Described in bulletin OG-406.

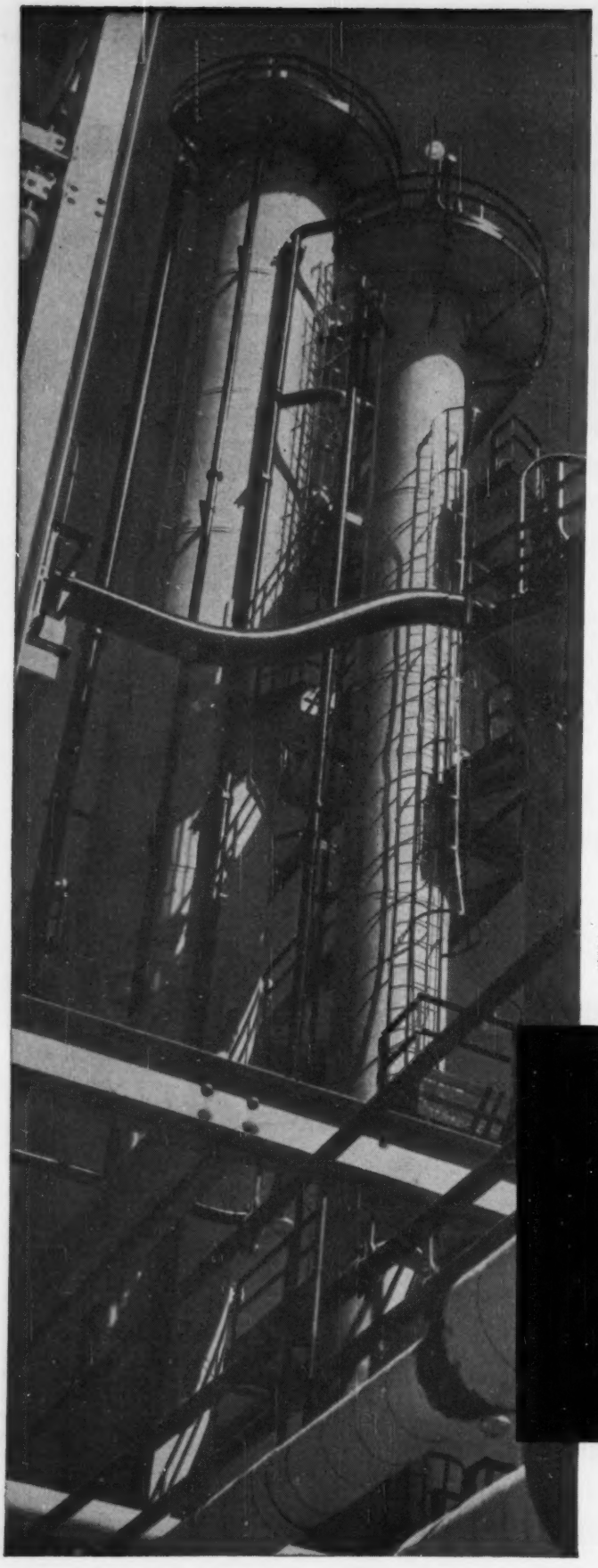
YOU CAN RELY ON ROCKWELL

CLIP COUPON—MAIL TODAY

ROCKWELL MANUFACTURING COMPANY **Dept. 104-G**
Pittsburgh 8, Pennsylvania

Gentlemen:
I am interested in measuring _____
(Name of Liquid)
Pipe Size _____"
Working Pressure _____ psi Temperature _____ °F max.
Max. Flow Rate _____ gpm Min. Flow Rate _____ gpm

YOUR NAME _____
COMPANY _____
STREET _____
CITY _____ ZONE ____ STATE ____



WELSBACH OZONE

. . . pathway to easier oxidations

You can cut costs and raise profits when you use Welsbach Ozone, because it takes the problems out of difficult oxidations!

Yes, you'll really brighten your process picture with this versatile and efficient oxidant. You'll work with a constantly available material under lower pressure and temperature requirements. Reactions will be of higher specificity, product yields will climb sharply.

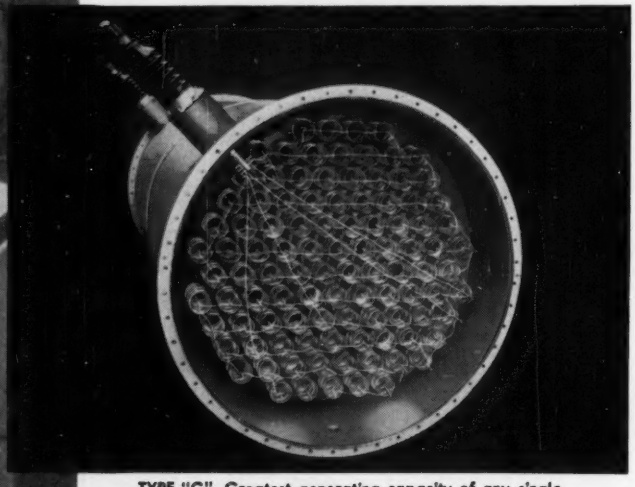
Back of ozone are the long-range benefits you'll get from Welsbach's constant research toward even lower costs, process improvement and new application development.

Here indeed, then, is industry's outstanding oxidant . . . and the logical choice to help you eliminate your oxidation problems!

Let us help you solve those problems. We're ready to put our extensive experience, technical knowledge and research to work analyzing your particular needs. And in all likelihood we can come up with the answers that will lead to better products for you, in increased quantities, at lower costs. In your plant . . . in your process . . . oxidize more effectively with Welsbach Ozone. The Welsbach Corporation, Ozone Processes Division, 1500 Walnut St., Philadelphia 2, Pa.

WELSBACH OZONE

FIRST IN OZONE RESEARCH



TYPE "G". Greatest generating capacity of any single ozonator ever built. Produces up to 120 lbs. of ozone per day.

new SPERRY "HANDRAULIC" portable type Closing Device

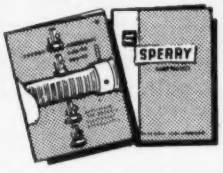
EASIEST to INSTALL and OPERATE . . . .



BRINGS NEW FILTRATION ECONOMY TO NEW OR EXISTING FILTER PRESSES!

Now — without re-boring . . . without altering parts . . . without removing so much as one plate — you can modernize your present filter press with one of the newest, most advanced of all labor-saving devices — the "HANDRAULIC" Closing Device by Sperry. (Or you can specify the "HANDRAULIC" as original equipment on new Sperry Filter Presses.)

On existing presses, simply remove one bolt . . . slip the "HANDRAULIC" in place . . . tighten the cap-screw . . . and that's it! Releases a powerful hydraulic surge for opening and closing the filter press . . . in seconds . . . without operator fatigue. And because the "HANDRAULIC" requires no extra support or foundation, it's practically portable. Replaces the filler block . . . takes up no extra space . . . and angles out of position to provide the maximum space for cleaning and maintenance.



SEND FOR FREE NEW BOOKLET

describing the "HANDRAULIC'S" simple erection and operating directions that can save you time, labor, material, and money. Also ask for Sperry's new, illustrated 42-page Filter Press Catalog. Both books are important . . . both are free. Send for your copies, today!

Eastern Sales Representative:
George S. Tarbox, 808 Nepperhan Avenue, Yonkers, N. Y. Yonkers 5-8400

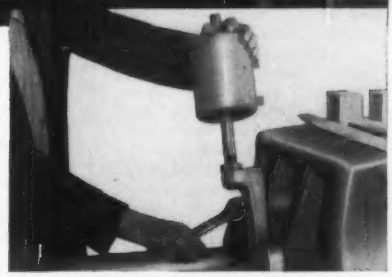
Western Sales Representative:
B. M. Pilhashy, 833 Merchants Exchange Bldg., San Francisco 4, California DO 2-0375

Filtration Engineers for More than 60 Years

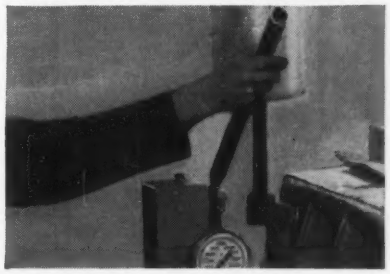
D. R. SPERRY & CO.

5C

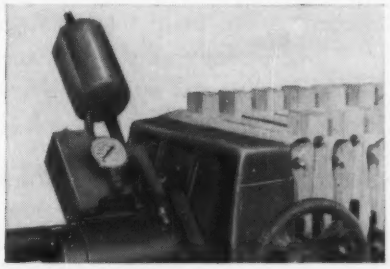
BATAVIA, ILLINOIS



"ONE-BOLT" INSTALLATION!



"ONE-MAN" OPERATION!



"ONE-MOTION" CLEANING PROCEDURE!

Swing Handraulic to horizontal position, move slide head to open position, and filter press is ready for cleaning.



we took the heat off Herman!

Saved him from a horrible end, he says. From what Herman, a refinery supervisor down Houston way tells us, CE's *Inventory Issue* kiboshed a CPI tragedy right in his own home.

Seems his wife was pretty proud of her sewing. So was Herman – always talking it up at the plant about how much dough she saved on clothes. Only trouble was, she just had one pair of scissors, and Herman was forever borrowing 'em to cut out reading material from CHEMICAL ENGINEERING.

The day the *Inventory Issue* arrived though, he knew his snippers-snitchin' days were over. Saw right away how it wrapped up 12-months' key developments and eliminated his clip-and-file system in one fell swoop. New technologies, new plants, new chemicals and equipment, that wonderfully convenient Reader Service . . . *the works!* He was in ecstasy.

Couldn't understand when he told his wife about it though. She just up and fainted. Later, he keeled over himself when he found out she'd planned a scissorcide the next time he grabbed her shears.

But all's well now. A little vacation did the trick for mama. Today there's no happier CPI couple east of the Pecos. No snips around the house though – the little lady's clothes are all store-bought. And the only bragging Herman does at the plant is about *how much time he saves* . . . with the *Annual Inventory Issue of* CHEMICAL ENGINEERING.

ANNUAL INVENTORY ISSUE

Chemical Engineering

A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, N.Y.



Thermocouple Head Model 501
Heavier wire provides ruggedness. Higher operating temperature keeps filament clean . . . less subject to ambient temperature changes. Not damaged by exposure to atmosphere. Price **$9.50**

Thermocouple Control Model 701
Operates at 115 volts, 50/60 cycles, for use with 501. Range 10^{-3} to 1 mm Hg. Price **$110.50** (excluding head) Multi-point and recording units also available.

Pirani Gauge Model 516
Two scales — 0 to atmosphere and 0 to 20 microns — provide greater accuracy. Relatively unaffected by line voltage or temperature changes. Independent of cord length. Not damaged by exposure to atmosphere. Outgassing circuit provided. Price **$160.00**

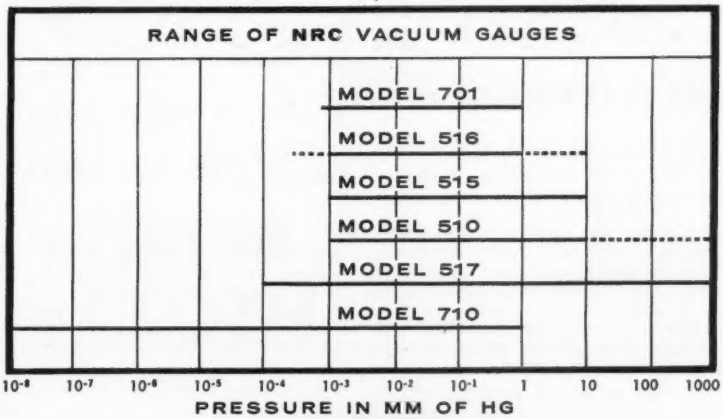
Alphatron® Ionization Gauge Model 515
All Alphatron® vacuum gauges have burn-out proof radium source ionization which provides emission stability, minimizes contamination, assures instantaneous response, high accuracy, long life. Model 515 has direct reading, single logarithmic scale covering the range 10^{-3} to 10 mm Hg. Price **$225.00**

Alphatron® Ionization Gauge Model 510
Has all the advantages of radium source ionization. Provides direct accurate readings with instantaneous linear response from 10^{-3} to 10 mm Hg in three ranges and non-linear extended range to 760 mm Hg. Separate ionization chamber reduces effects of contamination. Recorder or controller connection can be added. Price **$520.00**

Alphatron® Ionization Gauge Model 517
Has all the advantages of radium source ionization. Provides accurate measurement over the widest range of any AC-operated vacuum gauge. Six ranges covering pressures from 10^{-4} to 1000 mm Hg. Linear response with high stability. Connection provided for recorder or controller. Price **$425.00**

Ionization Head Model 507
Widely spaced pins minimize leakage due to dirt, corrosion — retains accuracy. High sensitivity maintained. Dual filament system provides "double life." Price **$20.00**

Thermocouple-Ionization Control Model 710
Controls two 501 and one 507 heads. Range 2×10^{-5} to 1 mm Hg. Protective circuit guards ionization head against burn-out from excessive pressure bursts. Emission control circuit holds electronic variables constant, allows single meter, more reliable readings over all ranges. Price **$357.50** (excluding heads)



For years laboratory and production technicians at National Research have been pioneering new developments in high vacuum . . . designing, installing and operating high vacuum systems that are producing millions of dollars worth of product successfully year after year. In their determination to provide themselves with the finest instrumentation possible National's technicians have designed and built their own Vacuum Gauges. Here is the complete line.

In the field of High Vacuum — you can always depend on National Research.

SALES OFFICES
Boston, Chicago, Cleveland, Houston, Los Angeles, New York, Palo Alto, Philadelphia; in Canada: Toronto, Arnprior

NRC
NARESCO
EQUIPMENT
CORPORATION

NARESCO EQUIPMENT CORPORATION
Equipment Sales Subsidiary of National Research Corporation
Dept. 57, Charlemont St., Newton Highlands 61, Mass.
Please send me the NRC Vacuum Gauge Bulletin.

Name.....
Company.....
Address.....
City.....State.....

A WIDE RANGE OF ACCURATELY
REDUCED PRESSURES
with
DAVIS



PRESSURE REGULATORS

Here's positive, accurate pressure reduction in a range from 1 to 100 pounds. The Davis No. 13 is ideal for control of unit heaters, steam kettles, vulcanizers, presses, sterilizers and other small equipment. Tight closing ... non-sticking feature assures long dependable operation and minimum maintenance, easy servicing. Built-in strainer for easy cleaning. Install Davis pressure regulators for least in maintenance, tops in dependability.

- *BUILT-IN STRAINER* for easy cleaning, positive protection!
- *ORIFICE TYPE VALVE* for tight-closing, non-sticking operation.
- *BRONZE, SEMI-STEEL, OR STEEL BODY*—special alloy trim available.
- *COMPLETE RANGE OF SIZES*—⅜, ½, ¾, 1, 1¼, 1½ and 2 inches.



SEND FOR NEW CATALOG
No. 200—Features pressure regulators, altitude valves, pump governors, emergency valves and relief valves.

Davis
DAVIS REGULATOR COMPANY
2539 So. Washtenaw • Chicago 8, Illinois

CENTRIFUGAL SYNTHESIS GAS CIRCULATOR



GHH MAULWURF PUMPS are High Pressure Centrifugal Gas Circulators which are especially designed for application in the chemical industry for increasing the pressure of the nitrogen-hydrogen mixture used in the ammonia synthesis

The extensive fabrication program of our Mechanical Engineering Division comprises among others
COMPRESSORS • EXPANDERS
BLOWERS • HEAT EXCHANGERS
GAS CIRCULATORS • PRESSURE VESSELS • COLUMNS • STORAGE TANKS

GUTEHOFFNUNGSHÜTTE
STERKRADE AKTIENGESELLSCHAFT • STERKRADE WORKS • GERMANY

REPRESENTATIVES: **The Foram Corporation**
76 Beaver Street, NEW YORK 5, N. Y. • Telephone: Whitehall 3-3881



WE LIKE PLAYING POST OFFICE!

Don't blame us for grinning at those tired mailmen. We're happy 'cause you're flooding us with correspondence on CE's first *Annual Inventory Issue.*

The editors have been snowed under with comments, compliments, criticisms . . . Reader Service requests will hit 100,000 before the next issue's out . . . and thanks to you, we're getting plenty of new ideas for the 1955 edition.

Keep 'em coming . . . but hurry! Publishing date's October . . . and we want all the help we can get to make this year's *Inventory Issue* better'n ever.

ANNUAL INVENTORY ISSUE

Chemical Engineering

A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, N. Y.



"LIQUIDS WORTH STORING ARE WORTH MEASURING" WITH A

LIQUIDOMETER *Tank Gauge*

WRITE FOR COMPLETE DETAILS

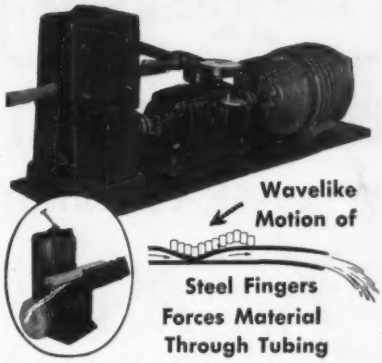
THE **LIQUIDOMETER** CORP.

36-29 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

PUMP

Liquids • Gases • Slurries

WITHOUT CORROSION OR CONTAMINATION



Prices range from ..... $55 to $500
depending on size of pump and accessory equipment required.

Write for Catalog

SIGMAMOTOR Inc.
17 NORTH MAIN ST. MIDDLEPORT N.Y.

• *Our Suggestions on the Selection and use of*

• **FILTER**
• **CLOTH**

have often proved most profitable to our clients . . .

we suggest you let us know

The Product You Are Filtering—Type of Equipment You Operate—Plate and Frame Or Rotary Filter—Whether Acid or Alkaline Solution—Temperatures—Pressure—WE WILL MAKE SOME SUGGESTIONS.

•

then we can suggest

Over 40 different cotton weaves, including filter twills, chaincloths, and filter flannels. We also handle synthetic fabrics for acid and alkaline solutions—Nylon, Orlon, Dynel, Polyethylene, Dacron, Saran. Woven glass cloth for highest temperatures.

These cotton and synthetic fabrics are furnished by the yard or by the roll or cut and fabricated to meet your requirements.

We suggest you write for

FACTS AND FIGURES ABOUT FILTER CLOTH

Contains actual samples and performance characteristics on Stanley Corrosion-resistant Filter Cloths. Also ask for Folder on Victor Centrifugal Bags and Filters.

WM. W. STANLEY CO. INC.

401 BROADWAY NEW YORK 13, N.Y.

ALUMINUM

Custom Fabricated

EQUIPMENT

including

- Pressure Vessels
- Storage and Processing Tanks
- Heat Exchangers
- Towers
- Gratings
- Ladders and Walkways

Our pressure vessels and tanks are designed and built to comply with the requirements of the ASME code and we are authorized to apply the appropriate symbols.

Write for literature

WASHINGTON ALUMINUM COMPANY, INCORPORATED
BALTIMORE 29, MARYLAND
Phone: ARBUTUS 2700

New York Office—MU 7-0926

ILLCO-WAY
ionXchange

IRON REMOVAL

BY ANION EXCHANGE

~~Fe~~ ~~$FeCl_3$~~

PRACTICAL equipment has now been developed to effect the removal of contaminating iron from commercial hydrochloric acid, aluminum chloride, and comparable products. For many years, industry has looked on some iron content in these products as acceptable, though undesirable. In recent years, research chemists have shown in the laboratory that ionXchange *could* be used to remove such iron and produce water-white solutions. NOW Illinois Water Treatment Company has designed and built the *practical* equipment to accomplish this purpose *economically* on a commercial scale.

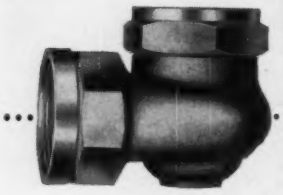
USES **WATER** AS A REGENERANT

One seemingly strange feature of the process is that plain *water* is used as the resin regenerant, instead of an acid or caustic as in the more familiar ionXchange operations. The iron, in the form of ferric chloride, is adsorbed by a strong-base quaternary type anion exchange resin. Thorough tests indicate low cost and reliable operation with no abnormal effects on the capacity or condition of the resin. *The same process can be used for decontaminating hydrochloric acid used in baths for pickling steel.* Write for complete information . . .

ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
844 CEDAR ST.
ROCKFORD,
ILLINOIS

NEW YORK OFFICE: 141 E. 44TH ST. NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

SPRAYING SYSTEMS CO.



for lower cost

and better performance

SPRAY NOZZLES

Modern design. Precision machining. All materials. Thousands of standard industrial spray nozzle types and sizes to choose from. Years of proved experience at your service.



write for this great new catalog today

Ask for our new 48 page Catalog No. 24 . . . the most comprehensive spray nozzle catalog ever produced. Yours for the asking.

SPRAYING SYSTEMS CO.
3275 Randolph Street • Bellwood, Illinois

New Type Eppenbach

COLLOID MILL

Featuring

Large Tangential Outlet which prevents back pressure and allows increased output capacity
Both Rotor and Stator are Interchangeable Stellite rings and stones—facilitating replacement when required.
Sanitary fittings throughout.
Illustration shows large production Mill Model QV-11 with 15 H.P. motor

Eppenbach Colloid Mills operate at speeds approaching the theoretical minimum required for true wet micro grinding—shaft speeds up to 10,000 r.p.m. depending on size and type of mill.

These Mills assure uniform grind through advanced engineering features including (1) Improved ball bearings which center the shaft and minimize lateral whip and (2) Invar shafting with zero coefficient of heat expansion.

All Mills can be made with pressure feeds and jacketed hoppers.

Consult our Sales Department with your technical problems.

Write for literature describing *Eppenbach* equipment —now manufactured and sold by:



Direct-drive model shown operates at 3500 RPM. Higher speeds can be furnished. Colloid Mills made in all sizes from ¼ H.P. model laboratory size to 50 H.P. model.

ADMIRAL TOOL & MFG. CO., INC.

45-10 VERNON BOULEVARD
LONG ISLAND CITY, 1 N. Y.

IF THIS IS YOUR PROBLEM

If you need effective, highly readable, smartly illustrated company literature (booklets, pamphlets, manuals) to display your products, inform the public of your operations, attract key personnel to your plant, train employees, and perform any of the other communicative functions that are vital to your business . . .

THIS IS YOUR ANSWER

The McGraw-Hill TECHNICAL WRITING SERVICE has a staff of more than 150 highly-trained writers, editors, and illustration specialists whose job it is to create technical and general literature for industry. We write, illustrate, design, and print Equipment Manuals, Product Bulletins, Handbooks, Company Histories, Annual Reports, and other specialized material. Save money and time. Let our staff be your staff for Technical and Business publications.

This service is available through ad agencies.

Write • Phone

TECHNICAL WRITING SERVICE
McGraw-Hill Book Co., Inc.
330 W. 42nd St., N. Y. 36, N. Y.
LOngacre 4-3000

ANNOUNCING A NEW SERVICE AND A PROCESS FOR MAKING

ARCHED WAFERS

OF

YOUR PRODUCT

•

MANY ADVANTAGES OVER FLAKES OR OTHER SHAPES

For Further Information About Our Confidential Service Address:

FLAKICE CORPORATION
360 FURMAN ST.
BROOKLYN 1, N. Y.

WHERE TO BUY

Featuring additional Equipment Materials, Supplies and Service for the Process Industries

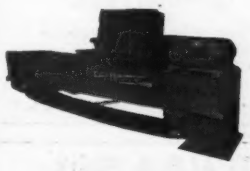


MOLDED BLACK NYLON SCREWS & NUTS 10 STOCK ITEMS

6/32, 8/32, 10/32. No Conduction. No Corrosion. Eliminate Insulating Bushings.

Free Sample—WRITE

WECKESSER CO.
5264 Avondale Chicago 30



FEED MATERIAL BY WEIGHT

•

MERRICK FEEDOWEIGHT

MERRICK SCALE MFG. CO.
171 SUMMER ST., PASSAIC, N. J.

5 CORROSION CONTROL SERVICES . .

You'll Find Metalweld Services A Sound Investment, Not An Expense!

1. **SYNTHETIC RESIN COATINGS** — Application of Vinyl, Epon, Baked Phenolic, Neoprene, Thiokol Coatings in the MW Plant and in the field. RR siding for lining tank cars.
2. **RUBBER LININGS** — Rubber and Koroseal Sheet Linings applied to tanks, pipe, process equipment, etc.
3. **METALLIZING** — Sprayed Zinc and Aluminum for Corrosion Protection. Metal Spraying to build up parts, rolls, shafts, journals, etc.
4. **MW PLASTICOTE LINING** — Applied to hot water tank interiors — eliminates rust — passes inspection.
5. **SURFACE CLEANING** — Sand and Steel Grit Blasting in the large MW blastrooms or in the field.

CONSULT BEFORE YOU SPECIFY
Send Us Facts or Ask for Literature!

PROTECTIVE COATINGS DIVISION
METALWELD, INC.
Scotts Lane & Cresson Ave.
Phila. 29, Pa • Victor 8-1810

TANK-O-METER
FOR MEASURING TANK CONTENTS ANY DISTANCE AWAY
ANY LIQUID

Uehling
INSTRUMENT CO.
491 GETTY AVENUE, PATERSON, N. J.
SEND FOR BULLETIN 945

CHEMSTEEL CONSTRUCTION COMPANY, INC.
501 Chemsteel Bldg., Walnut St., Pittsburgh 32, Pa.

Send data on Engineering & Construction facilities for
ACID-ALKALI-PROOF CONSTRUCTION
of processing & storage tanks & flooring.

NAME.....
COMPANY.....
ADDRESS.....
CITY.....ZONE.....STATE....

Make it a habit

to check, each issue, the announcements appearing in this
WHERE TO BUY SECTION
They supplement other advertising in CHEMICAL ENGINEERING of products and services essential to modern chemical plant operation.

PROFESSIONAL SERVICES

PROCESS DEVELOPMENT & PILOT PLANT WORK
PLANT CONSTRUCTION & ERECTION
PROCESS & PLANT DESIGN
EVALUATION AND APPRAISAL
EQUIPMENT DESIGN
SYSTEMS ENGINEERING
INSTRUMENTATION
CATALYST DEVELOPMENT
TRANSLATIONS
CHEMICAL & BACTERIOLOGICAL ANALYSIS
PATENTS
PLANT SITE SELECTION
MANAGEMENT
GENERAL CONSULTING

R. S. ARIES & ASSOCIATES
Consultants to the Chemical Industries
New Products and Processes
New Product Development
Design & Initial Operation of Complete Plants
Process Analysis — Market Research
COMPLETE TECHNICAL & ECONOMIC SERVICES
270 Park Ave. EL 5-1430 New York 17, N. Y.

Consult these SPECIALISTS
Let them save your time by bringing their broad experience in their specialty to bear on your problems.

PILOT ENGINEERING COMPANY
RESEARCH & DEVELOPMENT
From idea through pilot plant
DESIGN
Process—Equipment—Complete plants
PRODUCTION
Supervision—Trouble shooting
Improvements—By-product recovery
P.O. Box 4258 Washington 12, D. C. WEbster 5-6807

W. L. BADGER
309 South State Street Ann Arbor, Mich.
CONSULTING CHEMICAL ENGINEER
Evaporation, crystallization, and Test Transfer; Complete plants for salt and caustic soda; Complete Dowtherm installations.

THE KULJIAN CORPORATION
Consultants • Engineers • Constructors
Chemical • Industrial • Process
1200 N. Broad St. Phila. 21, Pa.
Offices Throughout the World

SANDERSON & PORTER
Engineers and Constructors
Reports and Surveys
New York, New York

BROWN, BLAUVELT & LEONARD
Chemical & Industrial Engineers
"Dependable Engineering For Profitable Operations"
470 Fourth Avenue
New York 16, N. Y.
MU. 6-4712

R. B. MACMULLIN ASSOCIATES
Chemical and Electrochemical Plants
Complete Process and Project Engineering
Research Guidance Economic Surveys
610 Hancock Bldg. Niagara Falls, N. Y.

S. SCHWARTZ & ASSOCIATES
CONSULTING ENGINEERS
Specializing in Sulfur & Sulfur-containing Materials
Technical & Economic Studies — Cost Reduction & Evaluations — Processes & Designs — Trouble Shooting — Advice To Financial Groups
165 Broadway, New York 6 Rector 2-4028

CARL DEMRICK
Technical Translations
Send for Circular
52 So. Broadway Yonkers, N. Y.

CHAS. T. MAIN, INC.
Engineers
Industrial Plants
Reports Design Supervision
80 Federal Street Boston 10, Mass.
317 So. Tryon Street Charlotte, North Carolina

J. E. SIRRINE COMPANY
Engineers
Plant Design & Surveys covering Chemicals, Electrochemical and Metallurgical Production; Trade Waste Disposal; Water Supply & Treatment; Analyses & Reports.
Greenville - - - - - - - South Carolina

HALE AND KULLGREN, INC.
Specialists in Processes and Plants for Rubber and Plastics
A Complete Engineering Service including: Economic Surveys; Process Design; Installation; Contracting and Operation
613 E. Tallmadge Ave. Akron 10, Ohio

C. L. MANTELL
Consulting Chemical Engineer
Process Research and Engineering Development
457 Washington Street New York 13, N. Y.

MARCUS SITTENFIELD
Consulting Chemical Engineer
Plants - DESIGN - EQUIPMENT
Economic - SURVEYS - Technical
Process DEVELOPMENT - Product
Registered Professional Engineer
1411 Walnut St. Philadelphia 2, Pa.

JOHN J. HARTE CO.
Engineers • Constructors
Chemical • Process • Industrial
Petro • Fertilizer • Pulp & Paper
Water • Wastes • Material Handling
284 Techwood Dr., Atlanta, Ga.
New York • Washington • Foreign

METCALF & EDDY
Engineers
Industrial Waste Treatment
Water Supply and Water Purification
Stream Pollution Investigations
Laboratory
Statler Bldg. Boston 16

TECHNICAL ENTERPRISES, Inc.
Engineers - Consultants - Chemists
to
Chemical — Food — Pharmaceutical Industries
Complete Engineering Services
Product & Process Research & Development
SPECIALISTS IN SMALLER MANUFACTURING PLANTS
31 South St., New York 4, N. Y. WH 3-1544

KOHN & PECHENICK
Consulting Chemical Engineers
Plants — Process — Equipment
DESIGN
Reports Trouble-Shooting Appraisals
262 Huron St. Brooklyn 22, N. Y.

JAMES P. O'DONNELL
Engineer
CHEMICAL AND PETROLEUM PROCESS PLANTS
Design-Procurement-Construction Supervision
Start-Up
New York, N. Y. Beaumont, Texas

LEONARD M. TODD
Consulting Chemical Engineer
CHEMICAL AND INDUSTRIAL PLANTS
PROCESS SURVEYS - PATENT REPORTS
24 Fifth Avenue New York 11, N. Y.
GRamercy 3-6400

KNOWLES ASSOCIATES
Chemical—Metallurgical—Mechanical Engineers
Consultation — Design
Complete Plants — Equipment
Heavy Chemicals — Ore Dressing
19 Rector Street New York 6, New York
Bowling Green 9-3456

PATCHEN AND ZIMMERMAN ENGINEERS
Chemical, Process, and Industrial Plants
Investigations—Reports—Design—Supervision
Augusta, Ga. Atlanta, Ga. Anniston, Ala.

THE J. G. WHITE ENGINEERING CORPORATION
Design - Construction - Reports - Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.



Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

DISPLAYED —RATES— **UNDISPLAYED**

The advertising rate is $19.50 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$1.50 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to CHEMICAL ENGINEERING, 330 W. 42nd St., N. Y. 36, N. Y. for August issue closing June 29th

WANTED:

CHEMIST or ASSAYER

For analytical work on tungsten ores and concentrates. Previous experience necessary. Location—southeast.

P-6695, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Wanted: Graduate Engineers, preferably chemical for both headquarters consulting and field sales work. For sales, should have 3 or more years successful record. For consulting, young men preferred so that our business can be taught to them and then can move up in subsequent years. Write P-5460, Chemical Engineering.

Wanted—Young graduate chemist interested in analytical and control problems associated with flour and prepared mixes. A good opportunity to quickly advance in this growing field. Write Box No. 468, Omaha, Nebraska.

Permanent Wave Research Chemist. Old established cosmetic and permanent wave manufacturing concern in Middle West has fine position available for top research chemist. Permanent position with exceptional future for right man, in fast-growing concern. P-6604, Chemical Engineering.

The City of Dallas has an opening at the present time for industrial waste engineer 14. The requirements on this job are as follows: equivalent to degree in chemical engineering, plus five years experience in chemical engineering work involving treatment of industrial plant waste. Salary range is $411 to $548 per month.

EMPLOYMENT SERVICES

Salaried Positions $5,000 to $35,000 . We offer the original personal employment service (established 45 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 653 Brisbane Bldg., Buffalo 3. N. Y.

Salaried Personnel, $3,000-$25,000. This confidential service, established 1827, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. P, 241 Orange St., New Haven, Conn.

POSITION WANTED

Graduate Engineer: 24 years of chemical and mechanical engineering background in chemical industry, power plants and water treatment. Includes all phases from designer to top level administration of major projects and also start-up and plant betterment. Desire opportunity to utilize talents at top level with medium sized chemical entity or consulting engineers or contractor. Presently employed. Available on reasonable notice. PW-6306, Chemical Engineering.

CHEMICAL OPENINGS

Outstanding manufacturer in the field of adhesives and coatings has three openings available on its staff. Each opening is a challenge to your creative and development capacities. Many company benefits and good future for yourself with a progressive manufacturer. If you qualify for any one of these positions address your reply, in confidence to the Personnel Director, Box No. Salary commensurate with background and experience.

1. CHEMIST—Either a graduate chemist or chemical engineer for adhesive and coating laboratory development. Must have experience with synthetic elastomers and resins.

2. CHIEF CHEMIST—For research and development laboratory specializing in synthetic elastomers and resin adhesives; nitrocellulose and modified cellulose adhesives and coatings. In addition to technical qualifications, applicant must have good administrative ability and experience in product control and plant production.

3. CHEMICAL FIELD TECHNICIAN—With good technical background in all types of adhesive and coating work. Must have experience as chemical sales engineer or as technical development man working with customers. Position involves field work connected with new produce market research and field development on new products.

P-6754, Chemical Engineering
330 W. 42 St. New York 36, N. Y.

CHEMICAL PROCESS INDUSTRIES
Manufacturer's Representatives

Now are engaged in selling to the allied chemical industries. Wish to expand line with selected top grade unit process or unit operation equipment. Territory: Manhattan and adjacent states.

RA-6473, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

CHEMICAL ENGINEERS

An active, confidential service! Interview at your convenience.
Call, write or wire
GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
220 So. State St. Rm. 628 Chicago 4, Ill.
HArrison 7-8600

CHEMISTS—CHEMICAL ENGINEERS

B.S. to Ph.D. Beginners—Experienced
We place EXCLUSIVELY with Chemical Companies
Call—Come In—Send 5 résumés
SELECTIVE PLACEMENT EMPLOYMENT AGENCY
17 William Street Newark, N. J.
C. A. Reed Jr., M.Sc. S. Goodman, M.Sc.

MANUFACTURERS REPRESENTATIVE
SELLING OPPORTUNITY WANTED

Manufacturers agent calling on chemical paint petroleum food plastics industries in Chicago-Milwaukee district wants line. Chemical engineer Illinois registered professional engineer.

RA-6713 Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

CHEMICAL ENGINEER
TRAINEES—TO $475

Large firm starting training program for process and production Engineers. Many other openings too.

CONTACT BOB POORE
O'SHEA EMPLOYMENT SYSTEM
"America's Largest"
64 E. Jackson, Chicago, Ill. Tel.—WAbash 2-1884

QUALITY CONTROL ENGINEERS

This is your opportunity to affiliate with a Company working in the field of atomic energy. We require the services of men with B.S. or M.S. degrees in Chemistry or Chemical Engineering. Training and experience in statistical quality control procedures necessary.

Three to five years' industrial experience in production or quality control work desired.

Our Company offers opportunity for rapid advancement, plus an outstanding program of benefits for employees.

MOVING EXPENSES PAID

Address Resume of Education and Experience to

EMPLOYMENT SUPERVISOR

National Lead Co.

OF OHIO

P. O. Box 158, Mt. Healthy Sta.
Cincinnati 31, Ohio

OPENING

AVAILABLE AT LONG ESTABLISHED MEDITERRANEAN COPPER PROPERTY

ASSISTANT CHIEF ENGINEER

Age limit 45 preferably about 35. Must be graduate mechanical, chemical or civil engineer with natural mechanical ability, excellent practical and supervisory and some construction experience, for charge under Chief Engineer of all shops, foundry, mobile equipment including loading, marine, railway and construction; maintenance and repair of all types of equipment; 7250 KVA diesel generating plant.

Forward with initial reply complete educational and experience records, list of references, age, marital status, number and age of children, photo (optional). Company offers three year contract, furnished house, transportation self and family, liberal vacations. Excellent climate, living conditions, medical and hospital facilities. School to 14 years. Non-contributory pension plan. Salary open.

P-6772, Chemical Engineering
1111 Wilshire Blvd., Los Angeles, Calif.

Our New

"MOLECULAR SIEVE" ADSORBENTS

Offer EXCELLENT OPPORTUNITIES

In Product & Application Development

For CHEMICAL ENGINEERS

Unusual career openings in the fields of adsorption, ion exchange and catalysis. Test marketing and customer liaison involved. Men with potential in technical sales may qualify later for responsible field positions.

Industrial experience desirable but not mandatory. Men under 30 preferred with Bachelors or Masters degree.

Write, sending resumé and approximate salary requirement, too:

LINDE AIR PRODUCTS COMPANY

a Division of

Union Carbide and Carbon Corporation
P. O. Box 44 Tonawanda, New York
Attention: Mr. Paul I. Emch

SALES ENGINEERS

We have openings for Sales Engineers in Detroit, Cleveland, and New York

We manufacture industrial instruments and have a complete line of Mechanical and Electronic Recorder & Recorder Controllers

Our resources are second largest in the industrial instrument field and Management is desirous of expanding sales. Excellent opportunities for graduates in Electrical, Mechanical and Chemical Engineering

P-6486, Chemical Engineering
330 W. 42nd St., New York 36, N. Y.

EXCLUSIVE TERRITORIES AVAILABLE

For firms or individuals to sell and service leading manufacturers complete line of

Corrosion Proof Materials and Construction

On Commission Basis. Locations Available: Alabama, Carolinas, Georgia, Kentucky, Minnesota, Missouri, Virginia, Kansas.

RW-4227, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

CHEMICAL ENGINEERS

Central Engineering Division of multi-plant manufacturer of diversified industrial chemicals needs several more engineers of 2-5 years experience. These positions offer opportunity for growth in an expanding organization. Work consists of process development and design, construction follow-up and operation consultation. Located in Central New York State.

P-6567, Chemical Engineering
330 W. 42nd St., New York 36, N. Y.

UTILITIES ENGINEER

(Foreign Service)

Chemical Engineer with minimum 5 years' experience in operational & maintenance phases of steam electric power plants.

Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 46

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

CHEMICAL ENGINEERS

Excellent opportunities open to men who are qualified for Process Development, Production and/or Engineering Design fields. The work is related to the expanding operations of a long established mid-western chemical company and will provide opportunities at most levels of experience.

Applicants must be eligible for security clearance by AEC, and should submit complete resume of personal data, education, previous experience, salary desired and references. All replies will be treated in confidence.

P-5551, Chemical Engineering
520 No. Michigan Ave., Chicago 11, Ill.

CHEMICAL ENGINEERS FOR RAYON FIBER PLANT

Chemical engineer, Ph.D., with desire for research work. Large synthetic fiber manufacturer with excellent facilities and growth potential. Qualifications difficult, but will reward acceptable person.

Chemical engineer, graduate degree preferred, to be an Assistant to the Technical Manager. Will deal with process and equipment. Should be under 35 years of age. Excellent opportunity for outstanding man.

Send full particulars to:

Director of Industrial Relations
COURTAULDS (Alabama) Inc.
P. O. Box 1076 Mobile, Alabama

pressure vessel designers

Educational and practical background in forces and stresses. Men who can handle other than standard methods of design. Shop experience and welding knowledge desirable. Reply fully to:—

C-29, P.O. Box 3414
Phila. 22, Pa.

CHEMICAL ENGINEERS-*Sales*

Graduate chemical engineers to sell industrial piping and related equipment to chemical and food-processing plants. Detroit and Cincinnati areas.

Salary, commission, automobile provided, group insurance, hospitalization, and retirement benefits.

Write, giving age, education, experience, salary requirements, and a recent photo. Replies confidential.

FISHER SCIENTIFIC CO.

Att: Secretary
711 Forbes Street Pittsburgh 19, Pa.

CHEMICAL ENGINEERING GRADUATES

Pillsbury Mills, leading food manufacturer, has unusual opportunities for young men in production and research trainee positions. Requirements:

1. Willingness to relocate.
2. Chemical Engineering Degree from accredited school.
3. Military service completed.
4. Under 32 years of age.
5. Experience not required.

Salary commensurate with background. Send detailed resume to:

R. G. B.
Personnel Department
PILLSBURY MILLS, Inc.
Minneapolis 2, Minnesota

THE STANDARD OIL COMPANY (OHIO)

Manufacturing (Refining) Department
is looking for

CHEMICAL ENGINEERS, CHEMISTS, and MECHANICAL ENGINEERS

with one to five years experience in petroleum refining or related activities
for staff work primarily in Cleveland, Ohio.
Possible employment in Toledo, Lima, or Cincinnati, also.

Applicant should have the following educational background and industrial experience:

Chemical Engineers: B.S. or higher degree and experience in development, pilot plant operation, process design, process trouble shooting, refinery process engineering, economic studies, or related work background.

Chemists: B.S. or higher degree and experience in product and process research or development.

Mechanical Engineers: B.S. or M.S. degree and experience in process equipment construction, design, inspection, or maintenance, petroleum product testing and field evaluation, or related work background.

Age range 22 - 32

Salaries commensurate with experience and level in organization. Advance on merit basis.

If you can qualify and are looking for a permanent job with a growing but secure midwest company, write, giving full information on education, industrial experience, military experience, and personal data to E. G. Glass, Jr., 1737 Midland Building, Cleveland 15, Ohio.

CHEMISTS
CHEMICAL ENGINEERS

Shape your future
In the fast-growing
SILICONE INDUSTRY

We need *chemists* (B.S., M.S.) for organic or inorganic research. PhD's for organic or rubber polymer research.

Chemical Engineers (B.S., M.S.) for pilot plants, sales, product development.

(Applicants must be exempt from military)

Send resume to—

Technical Personnel
Dow Corning Corporation
Midland, Michigan

OPENING

AVAILABLE AT LONG ESTABLISHED MEDITERRANEAN COPPER PROPERTY

ASSISTANT CHIEF ENGINEER

Age limit 45 preferably about 35. Must be graduate mechanical, chemical or civil engineer with natural mechanical ability, excellent practical and supervisory and some construction experience, for charge under Chief Engineer of all shops, foundry, mobile equipment including loading, marine, railway and construction; maintenance and repair of all types of equipment; 7250 KVA diesel generating plant.

Forward with initial reply complete educational and experience records, list of references, age, marital status, number and age of children, photo (optional). Company offers three year contract, furnished house, transportation self and family, liberal vacations. Excellent climate, living conditions, medical and hospital facilities. School to 14 years. Non-contributory pension plan. Salary open.

P-6223, Chemical Engineering
1111 Wilshire Blvd., Los Angeles, Calif.

CHEMIST or ChE

This opening poses interesting problems in fundamental thermodynamics and kinetic studies of high temperature gaseous systems . . . and requires at least 2 years' laboratory experience and acquaintance with electronics optics and shop practice.

The facilities available are of the best . . . with a large and diversified industrial leader located in the Midwest. Advantages include liberal benefits, and a stable future in the important field of jet aircraft.

Please write complete details, in confidence.

P-6812, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

WANTED
CHEMICAL ENGINEERS

LEADING MANUFACTURER OF HEAVY CHEMICALS REQUIRES CHEMICAL ENGINEERS WITH 2 YEARS EXPERIENCE. OPPORTUNITY FOR MAN WITH ENERGY AND ABILITY. MAIL RESUME, SALARY EXPECTED, AND RECENT SNAPSHOT TO PERSONNEL DIRECTOR, P.O. BOX 3269, TAMPA, FLORIDA.

OPPORTUNITY FOR SALES ENGINEER

Experienced in sales of Chemical Processing Equipment. Should have minimum of two years field experience or equivalent. Company located in Ohio has long, successful background and good customer relationship. Write

P-6534, Chemical Engineering
330 W. 42nd St., New York 36, N. Y.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS, $1.50 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $14.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W 42nd St., N. Y., 36, N. Y. for August issue closing June 29

FOR GOOD BUYS - LOEB

Agitators, portable: ¼ to 5 hp.

Centrifugals: Fletcher 12" copper, 17" stain. steel, 20" lithcoated.
Tolhurst 26" copper, 18" st. steel.

Clarifiers: De Laval 84-51, SVK5R, 94-21.

Collectors, dust: bag 5" dia. x 2½' to 5' long. Pangborn 2500 CFM.

Condensers: stainless steel and copper, various sizes.

Cutter: rotary, Abbe 000.

Dryers: Devine 2 x 4' vac. drum st. steel type 316.
Stokes vac. 20 shelf 40 x 44".
Hardinge 3 x 24' direct heat.
Buflovak 32 x 90" double drum.

Evaporator: Swenson triple effect 350 sq. ft., single effect 350 sq. ft.
Mojonnier st. steel, 392 sq. ft.
Rogers Special 6' stain. steel.

Exchanger, heat: Walker Wallace st. steel, plate type, 200 GPH.

Feeders: Syntron F-22, 10 x 36" trough.

Filters: Oliver 2½ x 1', Denver 1 x 3'. Sparkler, Alsop, Lomax, Industrial.

Filter Presses: Sperry, Shriver 6" to 36", recessed and plate and frame types.

Kettles: Stainless steel 20 to 150 gal., with and without agitators.
Devine 1500 gal. jacketed, agitated.

Mills: Pebble, Abbe 32 x 36" porc. lined.
Abbe 4½' x 4' porcelain lined.
Ball: Hardinge 3' x 8" steel lined.
Ball: Hardinge 5' x 36" buhr. lined.
Attrition: 30", two 40 hp. motors.
Mikro: 1SH, 2DH, 2TH.
Homoloid: Fitzpatrick model J, 3 hp.
Hammer: Jeffrey 30 x 24" type A
Hammer: Williams size BX type AK, 60 hp.
Raymond: 0000 IMp, 16" screen mill, Raymond laboratory Screen Mill.
3-roll: Day 12 x 32", Ross 12 x 30".

Mixers: Double and single arm sigma blade.
Dry Powder: 1½ to 77 cu.ft.
Dry Powder: Robinson copper body, 60 cu.ft. and 27 cu.ft.
Pony: Day 40 gal., O&T 20 gal.

Press: Davenport continuous #3A. Press, Tablet: Colton 3RB rotary.

Pumps: Centrifugal, rotary, gear, vacuum. In various sizes and metals.

Screens: Rotex 20 x 48" and 40 x 84".
Roball 40 x 120" stainless steel.
Selectro 4 x 10', Abbe Blutergess #1.

Sterilizers: Climax 20 x 36" jacketed.

Still, vacuum: 500 gal. Metal Glass stainless steel jacketed.

Still: water, Precision copper 100 GPH.

Tanks: Stain. steel to 1200 gal. cap.
Stain. steel rectangular 4x4x11'. Glass lined to 500 gal. cap.

WANTED: Rotary Vacuum Dryer 4' x 20', complete.

Send us your inquiries and list of idle equipment.

LOEB EQUIPMENT SUPPLY CO.

818 West Superior St. — **Chicago 22, Ill.**

Telephone: Seeley 8-1431 — ***Our 31st Year***

BALL MILL: One 10-½ ft. x 25 ft., 40 ton ball charge, 450 H.P. motor.

DRYERS: Ruggles Coles class XA18 size 104" x 65 ft. and class XA14 size 90" x 55 ft., complete with all auxiliary equipment.

MAGNETIC SEPARATORS: 2—Dings 3 roll and two five roll, complete with M.G. set.

COMPRESSOR: Chicago Pneumatic 19 x 11 x 12, OCE, 185 H.P., 440 volt, complete.

OVERHEAD ELECTRIC TRAVELING CRANES: 1—150 ton, 65' span, 230 volts, D.C.; one 20 ton, 54' span, 220 volt D.C. with M.G. set; and one 8 ton, 54' span, 4 motor, bucket operating, 440 volt, A.C. Other cranes both AC and DC, various spans, 5 tons to 55 tons, 3 and 4 motor.

BELT CONVEYOR: 24" x 500 ft., thoroughly modern, complete with supports: 1500 ft. new 24" belt.

LOCOMOTIVE CRANE: Link Belt 25 ton capacity, standard gauge, gasoline powered, cast steel trucks, air brakes, with or without 1-¼ yd. Williams clam shell bucket, thoroughly modern, excellent condition. Located Minnesota. For sale or rent.

LOCOMOTIVES: 2—65 ton diesel electric, standard gauge, thoroughly modern, excellent condition. For sale or rent.

WE BUY AND SELL EQUIPMENT THROUGHOUT NORTH AND CENTRAL AMERICA

A. J. O'NEILL
Lansdowne, Pa.
Phila. Phones: **MAdison 3-8300 - 3-8301**

AUTOCLAVE

FOR SALE:—Blaw-Knox Chrome-Vanadium Jacketed & Agitated Autoclave, 110 Gal., 200# psi. Internal. Details on request.

THE MACHINERY & EQUIPMENT CO.
533 West Broadway, N. Y. 12, N. Y.
GRamercy 5-6680

AVAILABLE

CUSTOM REFINING FACILITIES . . .

- Complete Distillation Service
- Distillations
- Extractions
- Fractionations Drum Lots—Tank Cars

WANTED

- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

Truland CHEMICAL & ENGINEERING CO. Inc.

Box 426, Union, N. J. — **Murdock 6-5252**

For Sale — **For Sale**

1—Eppenbach Stainless Steel Homo Mixer complete with ½ HP Explosion-Proof Motor.
2—Premier 8" Colloid Mills, Motor Driven.
1—10" Premier Colloid Mill.
2—Motor Driven Belt Conveyors.
3—Pony Mixers, 8, 15 and 40 gal.
High Speed Roller Mills 9"x24" to 16"x40".
1—J. H. Day 40-Gallon Pony Mixer.
1—Eppenbach Colloid Mill, Model QV-8-1.

SPECIALIZING IN REBUILT MACHINERY
WE BUY SURPLUS EQUIPMENT AND COMPLETE PLANTS

Irving Barcan Company
249 ORIENT AVENUE
JERSEY CITY 5, NEW JERSEY
Phone—DElaware 2-6695-6

FOR SALE

60" Centrifugal Extractors, Type 316 s.s.
Double Effect S.S. Evaporator.
Buflovak S.S. Spray Dryer, 500 lb. per hr.
36" x 84" Overton Double Drum Dryer.
50 to 200 gal. S.S. Mix Tanks, water jkt.
250 gal. Vertical S.S. Closed Tanks, agit.
300 gal. Horiz. S.S. Tank 3' x 7' agit.
650 gal. Horiz. S.S. Tank 4' x 7' agit.
1,000 gal. Horiz. S.S. Tank, 66" x 66", agit.
36" & 60" Mojonnier S.S. Vacuum Pans.
3,000 gal. Glass Lined Tanks, Insul.
75 gal. Monel Jkt. Kettle, 35" x 27".
75 to 1,500 gal. Homogenizers or Viscolizers.
26" Centrifugal Extractors, copper baskets.
30 Ton Howe Suspension Tank Scale.
3—#10BB Waukesha Pumps, 1 H.P.
Rietz Type #316 S.S. Mills, 75 & 100 H.P.

Send us your inquiries

LESTER KEHOE MACHINERY CORP.
1 East 42nd Street — New York 17, N. Y.
MU urray Hill 2-4616

WE NEED

All Kinds of Oil Refinery and Chemical Equipment, also Tanks

Write — Wire — Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
610 West 8th Street — Jamestown, New York

WANTED—SURPLUS

Chemicals—Dyes—Drugs
Colors—Pigments—Oils—Waxes
By-Products—Wastes—Equipment

CHEMICAL SERVICE CORP.
80-04 Beaver St. — **New York 5, NY**

LIQUIDATING FROM CLOSED PLANTS

JUST PURCHASED

Quadruple Effect Evaporator—total 6775 sq. ft., Veritcal, long tubes. Built 1946 by Goslin-Birmingham.

1—Traylor Rotary Kiln 10'6" dia. x 105" long, welded shell ¾"

2—Rotary Kilns 7' x 64'6"

2—Rotary Kilns 7' x 59'6"

1—Rotary Kiln 6' x 50'

1—Rotary Dryer 4'6" x 40'

1—Penn. Ring Type Granulator, Trojan K3-24, 40 HP

1—Allis Chalmers 6' dia. x 16' long steel lined continuous Ball Mill

3—Patterson & Abbe 4'6" dia. x 12' long Continuous Pebble Mills

2—Charlotte Colloid Mills, model #50, 75 HP motor

1—Bird solid bowl Centrifuge 36" x 50"

1—Bird 24" Horiz. Centrifuge

3—Muffle Furnace chrome nickle alloy tubes 24" x 8'6" long

3—Rotoclone Type W, size 20, Exhausters and Dust Collectors

1—Nash H-4 Hytor Compressor with 20 HP motor, Bronze

1—Ing. Rand type 20 Air Compressor, 30 HP

1—Worthington type HS steam driven gas Compressor, size 7 x 16 x 9, cap. 542 CFM deld. @ 15# pr.

1—Coppus 75 HP Turbine Drive

2—Coffin 68 HP Turbine Driven Centrifugal Pumps.

1—Copper Concentrating Column, 66" dia. x 47' high, 38 bubble can plates.

1—Copper Rectifying Column, 28"/40" dia.—66 bubble cap plates.

22—Ross and Patterson Shell and Tube Condensers and Heat Exchangers, pressure units, from 69 sq. ft. to 1320 sq. ft. sizes copper tubes.

1—Type 316 Stainless Steel Tanks, 5/16" thick, dished heads, heat treated and water quenched: 4200 gal. 6' dia. x 20' long

15—Taber and Ing-Rand Bronze Centrifugal Pumps, with motors.

1—Trough Belt Conveyor 15" W x 125' L

1—Trough Belt Conveyor 18" W x 85' L

1—Pan Conveyor, 24" W x 150' L

1—Pan Conveyor, 12" W x 85' L

IN STOCK

1—Blaw Knox 15 gal. Pilot Plant or Resin Kettle, T347 St. St. Agit. & Jktd. 150# pr.

2—Blaw Knox ½ gal. St. St. Autoclaves, 2000# pr., Agit.

1—2600 gal. T347 St. St. Jktd. Vacuum Tank

3—Fitzpatrick Comminuting Mach., D, D6&F

1—Conkey Triple Effect Evaporator, Herculoy, total 1900 sq. ft. Unused.

1—500 gal. St. St. Evaporator, 145 sq. ft. heating coil.

15—Distillation, Solvent Recovery and Absorption Col. lumns — 8" to 72" dia — Aluminum, Copper, Steel, Stainless Steel

1—Sharples 16P St. St. Centrifuge, pressure-tite. Used.

1—A.T.&M. 48" Susp. Centrifugal, Perf., St. St. Fume Tight

1—Stokes 3' dia. x 15' L Jacketed Rotary Vacuum Dryer

1—8800 gal. vacuum or Pressure Cooker with agitator and Vacuum pump, ASME

5—Atm. Double Drum Dryers, 22" x 38", 24" x 60", 42" x 120"

5—Shriver 30' x 30" C.I. Filter Presses, open del 28 to 50ch.

1—Sperry 15" aluminum P & F Filter, 29 ch.

2—W & P 100 gal. Sigma Blade Jktd. Mixer

2—Pebble Mills 6' D x 8' L.

20—Aluminum Tanks — 500 to 3000 gal.

9—Copper Tanks, 1723 to 2800 gal.

30—Agitator Drives 3 to 40 HP

5—1200 sq. ft. Steel Shell & Tube Heat Exchangers — Unused

HQ. FOR STAINLESS STEEL EQUIPMENT

USED EQUIPMENT IN STOCK

40—S.S. Storage Tanks from 30 gal. to 10,500 gal. sizes.
15—S.S. Pressure or Vacuum Tanks up to 4000 gal.
15—S.S. Shell & Tube and coil type Condensers and Heat Exchangers from 14 to 785 sq. ft.
40—S.S. Jktd. open top Kettles from 40 gal. to 500 gal.
5—S.S. Jktd. agit. closed Reaction Kettles, 15, 100, 450, 500, 1300 gal. sizes.
7—S.S. Side Ent. Agitators 10 HP to 25 HP.

CONVERTING OR CHANGING EXISTING EQUIPMENT—(Your own equipment or our stock)—Can be done in our own shops utilizing good used or surplus new materials.

FABRICATION—(IN OUR OWN SHOP)—Heliarc welding. Water-quenched stabilized welds. Large stock of type 304 and type 316 sheets and prefabricated tank sections and heads carried in stock assuring quick delivery of tanks.

Equipment Bought & Sold

Plants Liquidated

BOTTLING CANNING MACHINERY PERRY SUPPLIES PROCESSING

PERRY EQUIPMENT CORP.

Phone ST evenson 4-7210

Cable—PERI

1413 N. 6TH ST. PHILADELPHIA 22, PA.

MODERN REBUILT EQUIPMENT
At Bargain Prices - Immediate Deliveries

UNION Rebuilt Machinery Established 1912

MIXERS

650 to 850 gal. Jacketed Mixing Tanks. Day 35 to 75 gal. S. J. Imperial D. A. Mixers.

Day 650 gal. Jumbo S. J. Mixer.

Koven 2000 gal. Spiral Jacketed Mixer.

Stokes, Day New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.

Baker Perkins, Day Readco Heavy Duty, ½ to 160 gals., Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.

Gemco 56 cu. ft. Double Cone Blender.

J. H. Day 50 gal. Imperial S. S. Jacketed Double Arm Mixer.

Day, Robinson, 15 to 10,000 lbs., Dry Powder Mixers.

LABELERS

Resina LC, Capem, Elgin Cappers.

Burt, Knapp Wraparound Labelers, to gal.

Pony M, MX, ML, World, Ermold, Pneumatic Semi Automatic and Automatic Labelers.

FILLERS

Pfaudler-King C9, Horix Rotary Fillers.

S. & S. G1, G2, HG88 Duplex Fillers.

MRM S. A. Stainless Steel Vacuum Fillers.

Carter B1 Vacuum Powder Filler.

Triangle Elec-Tri-Pak G2C, A3A Fillers.

Elgin 5-Head, Hope 1, Filler 4-Head Stainless Steel Piston Fillers.

PACKAGING MACHINES

ABC Carton Sealer.

Standard Knapp 429 Carton Sealers.

Pneumatic Scale Cartoning Line.

Miller, Hayssen, Package Machinery, Oliver, Transwrap Wrappers.

TABLET MACHINES

Colton 2, 3 RP Rotary Tablet Machines.

Colton #5½ Punch Tablet Machine.

GRINDING MILLS—SIFTERS

Mikro 4TH, 3W, 2TH, 1SH and Bantam Pulverizers: Schutz O'Neill Mills.

Charlotte #3 Monel Colloid Mill.

Eppenbach V9 Aloxite Colloid Mill.

Rotex, Day, Robinson, Tyler Hummer, Great Western, Gayco, Raymond Sifters.

MISCELLANEOUS

Oliver, Sweetland #2, Sparkler, Sperry, Shriver, Alsop Filters.

OVER 5,000 MACHINES IN STOCK—INSPECTION INVITED

Complete Details and Quotations Available on Request

Immediate Deliveries

UNION STANDARD EQUIPMENT CO.
318-322 Lafayette Street New York 12, N. Y.

COMPRESSOR DIRECTORY
World's Best Rebuilts

AIR FOR SALE OR RENT SINCE 1902

Gas • Diesel • Steam • Electric

COMPRESSORS • VACUUM PUMPS

12.7 CFM	1000 psi	2 stage Ingersoll 5 HP Elec
48.6 CFM	3000	3 stage Ingersoll 25 HP Elec
60 CFM	500 psi	7/6x6 Worth VS-2
88 CFM	100 psi	6x5 Worth HB
93 CFM	100 psi	7x6 IR-Penn-Sull
105 CFM	Worth (gas)	portable
142 CFM	125 psi	6/6/5x5 Ingersoll Type 40—25 Elec
160 CFM	Worth (gas)	portable
168 CFM	125 psi	8½x9 Worth
211 CFM	100 psi	9½x9 American 40 HP Elec
234 CFM	100 psi	9x9 Worth HB
254 CFM	100 psi	10x10 Ingersoll ER-1 40 HP Elec
268 CFM	500 psi	10/4½x10 Ingersoll 75 HP Synch
278 CFM	125 psi	2 stage Chicago PB-50 HP Elec
321 CFM	125 psi	10x11 Worth HB
343 CFM	500 psi	11/5x13 Worth Elec or steam
354 CFM	Vacuum	14x5 Ingersoll Rand
364 CFM	20 psi	12x7 Gardner "RX" 2 available
460 CFM	125 psi	13/9x10 Ingersoll XRB—Duplex
500 CFM	Worth	(Diesel) portable
550 CFM	Vacuum	17x6 Chicago
676 CFM	125 psi	15/9½x12 Ingersoll XRB—Duplex
720 CFM	Vacuum	18x7 Worth HB
931 CFM	55 psi	17x13 CPT Elec or steam
1035 CFM	35 psi	20x12 Penn-3A 100 HP Elec
1184 CFM	Vacuum	22x9 Penn 7AT
1292 CFM	35 psi	20x13 Chicago T-B 125 HP Elec
1351 CFM	125 psi	18½-11½x8½ Worth YC2
1574 CFM	100 psi	22-14x16 Ing PRE2 250 HP
1681 CFM	Vacuum	24x13 Chic. TB
1723 CFM	110 psi	"XPV" 4 corner Ing. Steam
5780 CFM	60 psi	28-28x27 Ing PRE I 700 HP

American
AIR COMPRESSOR CORP
NORTH BERGEN, N. J.
Telephone UNion 5-4848

NEW AND GOOD - AS NEW EQUIPMENT

2—Buflovak Double Drum Dryers, 32"x90".
1—Stainless Tank #430 Chrome vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Robbins Vibrex 3x6 Vibrating Screen, single deck.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 160 gpm.
1—Buflovak Jacketed Impregnating Tank 42"x52".
1—4x8 Sturtevant Jaw Crusher.
1—Ribbon type Mixer steam jacketed.
1—Hardinge Conical Ball Mill, 6'x22".
1—Abbe Ball Mill, 140 gal., Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 360 gal.
2—Nash Air Compressors, Type AL-623.
1—Manton Gaulin Stainless Homogenizer, 125 gph.
2—I&R Vacuum Pumps, 5 H.P., 60" x 100'.
4—New Heat Exchangers, 12" dia. 11' lg., 43 steel tubes, 2 passes.
1—Kennedy-Van Saun Rotary Dryer, 4'x40'.
Davenport Rotary Steam Tube Dryer, 6'x36'.
1—Gruendler Hammer Mill, 10 H.P.—New.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22'—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
3—Dopp Kettles with agitators 600 gal. cap.
45—Steel Tanks from 100 to 100,000 gals.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors, 10 H.P. ea.
Robinson Ribbon Type Mixer 30"x10'—like new.
4—Horizontal Retorts 200# w.p., A.S.M.E., from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
1—Patterson Kelly Blender 5 cu. ft. Stainless Steel, with baffle plates and 1 H.P. motor.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—#10 J. H. Day 300 gal. Sigma Blade Mixer, Jacketed.

H. LOEB & SON :-: 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

ROTARY DRYERS—30" x 8'—3' x 32'—4' x 40'—7' x 80'

MIXERS—Ribbon 400/600/1000#, Lancaster EAG3 w motors

AUTOCLAVES—1 gal s/s-1000 PSI internal, jacketed

PEBBLE MILLS—15 gal porcelain jar—30 x 42—4' x 5'—6' x 4' porcelain lined—24 x 30 & 30 x 30 steel ball mills

HARDINGE MILLS—2' x 8", 6' x 22", 6' x 36" air swept w/loop classifier, 7' x 22", 7' x 36"

CENTRIFUGES—26", 40" Tolhurst, 48" Rubber, Haring Stephens & Laughlin continuous

FORK LIFT 7500# Hyster-New engine-pneumatics

FEEDERS—Hardinge "B", Syntron F44 w/selenium rectifiers, Morse 40 x 60 apron

NASH HYTOR—MD673-623-H-7-1253 w/motors

OVEN—54x48x66 gas fired-Roberts

COMPRESSORS—4 cfm-30 cfm-194 cfm w/motors & receivers

CRUSHING ROLLS—5 x 8 Sturt. lab 24 x 16, 30 x 16, 32 x 12, 42 x 16, 24 x 36 McLanahan single roll

PULVERIZERS—Gruendler 2XA, Wms. GA30, hammer mill (150 HP) Sturtevant #1 ring roll

LAWLER COMPANY
Durham Avenue Metuchen, N. J.
Metuchen 6-0245

DEPENDABLE PROCESS EQUIPMENT

All Items In Stock . . . Ready for Your Inspection And Immediate Delivery

S.S. Steam jacket kettles up to 1000 gal.
Powder mixers 50 to 5000 pounds.
Charlotte Colloid Mills, M3 & M50.
5 Spout SS Paste Filler, Automatic.
Pfaudler 10 gal. jkt. glass lined reactor, agitated.
Proctor & Schwartz Dryer, Gas Fired, 100' long.
Automatic Large Tube, Crimper & Closer.
S. S. Tanks 50 to 10,000 gal. agitation avail.
Boilers 2 h.p. to 1000 h.p. Oil or Gas Fired.
Mikro Pulverizer 4-TH with extra screens.
Lehman 5-roll Mill 12" x 36" water cooled.
Tolhurst 48" Centrifuge.
Laughlin Continuous Filter.
Link Belt Shaker 4' x 8'.
Proctor and Schwartz 84 tray dryer, and 5, 40 trays.
Portable Electric Mixers 1/3 to 3-h.p.
Tablet Presses single & rotary.

We Buy and Sell Complete Plants or Single Items

CALL, FIRE WRITE, YArds 7-3665

WE SELL THE WORLD OVER

NEWMAN TALLOW & SOAP MACHINERY CO. INC.
Established in 1880
1051-59 WEST 35th ST., CHICAGO 9, ILL.

DON'T MISS THE BOAT

Get aboard for real savings . . .

BUY BRILL

RE-NU-BILT EQUIPMENT

See Additional Listings on Page 408



DRYERS

1—Vulcan 8'x125' Rotary Kiln ¾".
3—Cummer 5'x40', 5'x30' Rotary.
1—Vulcan 4½'x50' Rotary.
1—Link Belt 6'4"x24' steel Roto-Louvre, Dryer Heresite coated.
1—Link Belt 3'10"x16' steel Roto-Louvre Dryer, furnace, oil burner, blower.
1—Devine #27 double door Vacuum Shelf, 17—59"x78" shelves.
1—Stokes Vacuum Shelf Dryer #138-H-10 44'x40" shelves.
2—Struthers Wells 5'x15' nickel clad Rotary Vacuum.
1—Devine 5'x10' steel Rotating Vacuum.
1—Stokes 30"x8', 3'x15' Rotating Vacuum.
4—Buflovak Double Drum 32"x100", 36"x84", 32"x72", 32"x52".
2—Buflovak 6' and 3' dia. Crystallizers.

FILTERS

3—Oliver Monel 8'x10', 3'x2' Rotary.
1—Oliver S.S. 8'x6' Rotary Vac.
2—Oliver 5'3"x6' Rotary Vac.
2—Sweetland #12—72, 36 leaves.
2—Sweetland #3 all stainless.
2—Sweetland #5, #7.
1—Niagara 110 sq. ft. S.S.
1—Sparkler # 33-S-17, steel.
3—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24" P&F.
1—Sperry 36" P&F, heresite.
12—Filter Press Skeletons, all sizes.

SCREENS

4—#82 Rotex double deck 40"x120".
1—Patterson single deck 40"x84" S.S.
1—#23 Rotex three deck 20"x80".
3—Tyler Hummer, 4'x10', 4'x5'.

CENTRIFUGALS

1—Bird 40" Suspended, 304 S.S.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32" Suspended, steel.
1—AT&M 36" rubber covered.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
1—Tolhurst 26" Suspended, 316 S.S.
1—Tolhurst 26" Suspended, rubber.
2—Sharples PN Super-D-Canters, SS.
2—Bird 18"x28" Continuous 310 SS.
2—Sharples C-27, C-20 stainless steel Super-D-Hydrators.
2—Sharples #16P Monel and S.S. Super Centrifuges.

SPECIALS

8—Day, Cincinnatus double arm Sigma Blade Mixers 660, 250 and 100 gals.
1—NEW Aluminum 25,000 gal. Vertical Storage Tank.
1—NEW 3000 gal. 304 S.S. Reactor.
1—DeLaval AC-VO "Nozzle-Matic" 304 S.S. Continuous Centrifuge.
1—350 sq. ft. 304 S.S. Heat Exchanger.
3—2400 sq. ft. Admiralty Heat Exchangers.
7—7'x25'6" Bubble Cap Tower, 347 S.S.

PULVERIZERS—CRUSHERS

1—Devine 5'x10' steel, jacketed Mill.
1—Raymond 5 Roll High Side Mill.
4—Hardinge Mills 4½x16", 5'x22" 5'x36", 6'x22", 10'x48".
4—Patterson 6'x8', 5'x6', 3'x4' brick-lined Pebble Mills.
1—Patterson 6'x8' porcelain (Berylite) Pebble Mill, 50 HP. NEW.
3—National 10"x20", 6"x12" Mills.
3—Gayco Air Separators 12', 8', 18".
6—Mikro Pulverizers #4TH, #3TH, #2TH, #2DH.

MIXERS

2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
5—Sprout Waldron S.S. jacketed Powder Mixers, 67, 27 and 10 cu. ft.
1—Struther Wells 6'x9' S.S. jacketed.
2—Baker Perkins 2 gal. stainless steel.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
3—Simpson Intensive Mixers #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gallon. Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

1—Buflovak 800 gal. 347 SS Clad, jacketed, agitated Reactor.
1—Buflovak double effect, Vertical SS Evaporator, 900 sq. ft.
7—Towers 6'x58' Chrome Lined, 6'x65', 6'x27', 5'x27', 42"x49', 3'x53', 30"x38'.
4—Foster-Wheeler Karbate Heat Exchangers 188 sq. ft.
12—Heat Exchangers 50 to 1350 sq. ft. S.S. & Admiralty.
5—Buflovak Condensers 20 to 90 sq. ft.
1—1400 gal. Aluminum Tank.

MISCELLANEOUS

10—Nash Vacuum Pumps TS12, TS8, H7, L3 MD571, #4, #2.
5—Stokes Vacuum Pumps 10 to 50 cfm.
14—Olivite, Duriron stainless steel Centrifugal Pumps 1" to 6".
10—Centrifugal Pumps 60 gpm to 2000 gpm, motor driven.
2—Stokes DD2, D3 Tablet Machines.
1—Kux Rotary Tablet Press 15-25.
2—Cumberland #0 Rotary Cutters.

IF YOU DON'T SEE IT LISTED—ASK FOR IT— WE HAVE IT

TEXAS OFFICE—4101 San Jacinto St., Houston 4, Texas—Tel.: Locust 1351

BRILL EQUIPMENT COMPANY
2401 THIRD AVENUE, NEW YORK 51, N. Y.
Telephone: CYpress 2-5703 • Cable: Bristen, N. Y.

A SINGLE ITEM OR A COMPLETE PLANT

Write, wire or phone us for complete information. Send us your surplus equipment lists today.

FOR BEST BUYS

1—Blaw-Knox 110 Gal. Jacketed Agitated Autoclave—2000# Pressure.
1—Davis Inconel Heat Exch. 195 Sq. Ft.
8—Devine Surface Condensers-Receivers 100 to 175 Sq. Ft.
1—Carrier 8 Truck Dryer—Glass En. Trays.
3—Devine Double Dr. Vac. Shelf Dryers.
1—4 x 9 Double Drum Atmos. Dryer.
8—12" to 42" C. I. Filter Presses.
2—Sweetland #10 & #12 Filters.
1—Pf. 100 Gal. Glass Lined Reactor.
2—Jack. Kettles Glass Lined 750 and 1000 Gals.
3—W. & P. 100 Gal. Double Arm Mixers.
1—Ross 100 Gal. D.A. Jack. Mixer.
3—Rotex Screens 20 x 48 to 40" x 120".
3—Stainless Steel Tanks 2100 & 4000 Gals. W/S.S. Coils
1—Buflovak Double Effect Evaporator, Stainless Steel.

Send for Bulletin A-34 with complete listings.

We buy your surplus

The MACHINERY & EQUIPMENT Corp.
533 West Broadway New York 12, N. Y.
GRamercy 5-6680

Harry Pearlman, Pres. - Bill Wolf, Vice-Pres.

For Sale
Bauer 19" ATTRITION MILL
Two 10 H.P. G.E. Motors.
W. J. MOFFITT, Duncannon, Pa.

STORAGE TANKS
—Prompt Shipment—

GLASS LINED TANKS — USED — 3000 gallon capacity. Welded construction — Fully insulated. Equipped with manhead. Suitable for milk, food products, lily white chemicals, solvents and fine lacquers.
VARNISH TANKS—USED—54" diameter x 14'6" high (or long) ¼" Steel—Welded construction—1700 gallons.
MISCELLANEOUS TANKS—Various sizes and types.

ERMAN-HOWELL DIVISION
LURIA STEEL & TRADING CORP.
332 South Michigan Ave.
Chicago 4, Ill.
Telephone: Wabash 2-0250

EQUIPONOMICS

BIRD CONT. CENTRIFUGE—36" x 50", S.S. 304
CENTRIFUGE—ATM Suspended, Steel, 45" complete with 40 H.P. TEFC motor, 2 sp.
CONDENSERS, 8—all monel, 75 to 100 sq. ft. Shell and tube.
DRYER, Buffalo, double drum, 32" dia. x 90". Reconditioned.
FILTER, Sperry—24", P & F, all bronze, 28-1" frames, NEW.
KETTLES, G/L Pfaudler, 200, 300, 500, and 1000 gal. complete.
NICKEL CLAD KETTLE, Jktd. Agit. 750 Gal. ASME.
FILTER—Oliver 3' x 4' S.S.
HEAT EXCHANGERS—500 sq. ft., Carpenter 20 S.S., 240 - 1' x 8' tubes.
We Buy Surplus Equipment and Complete Plants
PROCESS PLANTS SERVICE, Inc.
333 Rahway Avenue Elizabeth, N. J.
Phone: Elizabeth 4-2722

SAVE ON RAILS



BUY "GUARANTEED RELAYERS"

Handle more cars better — spend less to install & maintain with Foster Relayers. "Open-stock" shipments, all sections 12# thru 175# Switch Materials, Track items.
Send catalogs ☐ *Rails* ☐ *Track Equipment*
☐ *Send Free 'Track Maintenance' Book*

RAILS - TRACK EQUIPMENT - PIPE - PILING
L. B. FOSTER CO.
PITTSBURGH 30 NEW YORK 7
CHICAGO 4 HOUSTON 2 LOS ANGELES 5

PERSONNEL MANAGERS

LOOKING FOR ENGINEERS . . . . . TECHNICIANS?

Write for free copy of

"RESERVOIR OF ENGINEERS AND TECHNICAL MEN"

The engineers and technicians you want to reach are gathered in convenient, compact groups—as this 12-page booklet points out.

It keys the job titles these men hold to the McGraw-Hill publications they read for on-the-job information. It explains how you can make contact . . . channel, concentrate your employment advertising to just the men with the job qualifications you want . . . without wasting advertising money for higher-priced space in publications with general circulation, in which you pay for perhaps 999 unqualified readers for every 1 who may meet your job requirements.

Write for your free copy to: Classified Advertising Division

McGRAW-HILL PUBLISHING COMPANY, INC., 330 W. 42nd St., New York 36, N. Y.

Looking For Something?

—of course you are. Every reader of Chemical Engineering is.

Some find what they are looking for in the editorial pages, some in the advertising by manufacturers, some in the "Searchlight" advertisements. The latter includes many advertisements seeking, or offering "something"—a sales opportunity, used or surplus new equipment, or business opportunity that you may be able to supply, or want.

You will always find checking the "Searchlight" ads interesting, informative and, sometimes, profitable.

IN STOCK

CENTRIFUGES

Merco B9, SS, 15 HP.
Tolhurst, 20", SS, perf. basket.
Fletcher, 40", SS, perf. basket.
Sharples C20, SS, Super-D-Hydrator.
Sharples C27, SS, Super-D-Hydrator.
Sharples D-2 SS discs. NEW.
Sharples PN14, SS, Super-D-Canter.

COLUMNS

SS 18-8 Scrubber, 12"x15'.
SS 347 lined, Scrubber, 5'x18'.
SS 347, 6'x29', 21 trays.
Steel, 4'x53', 23 trays, 160 PSI.
Steel, 2'x47', 20 trays, 375 PSI.
Steel, 3'x49', 28 trays, 425 PSI.
Everdur, 5'x23', 24 trays.
Karbate #22, packed, 19"x28', 25 PSI NEW.

DRYERS

Rotary Vac. 5'x15' nickel clad.
Rotary 26"x8' oil fired with feeder.
Rotary Vac. 30"x8', Stokes 59AB.
Rotary 4'x27' oil fired, motor drive.
Rotary 5'x67' 6" lifters.
Rotary SS 304, 3'x20' Hersey. New 1947.
Rotary SS, 4'x30', complete.
Rotary Kiln 8'x125'x¾" firing hood.
Rotary Kiln 10'x200'x¾" oil & gas burners, comb. chamber, dust collecting system, 90 HP.
Roto-Louvre 604-24 complete w/furnace.
Roto-Louvre 705-20 SS heating coils comp.
SS Spray, 10'x36', gas fired.
Single drum, 5'x6' atm., scraper.

FILTERS

8'x12' Feinc, steel, string discharge.
8'x10' Oliver, steel, drum.
Sweetland #5, SS lined, hyd. closure.
5'x3' Feinc, string discharge, steel & rubber. NEW.
3'x4' Oliver, steel, complete.

HEAT EXCHANGERS

100 sq. ft. SS 40# shell 60# tubes.
205 sq. ft. SS 100# shell 200# tubes.
180 sq. ft. steel shell copper tubes.
198 sq. ft. steel shell 325# single pass, Adm. tubes 125# 2 pass.
252 sq. ft. steel 400# shell 150# tubes.
415 sq. ft. steel shell 125# single pass Adm. tubes 50# 4 pass.
550 sq. ft. steel 325# shell 160# tubes.
1035 sq. ft. steel 250# shell & tubes.
1800 sq. ft. steel shell Everdur tubes.
2200 sq. ft. steel 40# shell & tubes.
3300 sq. ft. steel 150# shell & tubes.

MIXERS

100 gal. Readco jktd. dbl. sigma blades power & tilt.
170 gal. Ajax dbl. arm, power dump.
1050 gal. Paddle dbl. shaft heavy duty NEW.
3900 gal. hor. jktd. 75 PSI paddle agitator ASME.
29 cu. ft. Patterson Conical Blender.
67-27-10 cu. ft. SS Sprout Waldron Powder jktd.
550 cu. ft. SS jktd. rotating oscillating Blender.
EXTRUDER—Stainless Steel Screw 2½".
HYDRATOR—LIME, Clyde #3.
KOMBINATOR—Flowmaster K200.
MICROSCOPE—Electronic RCA, complete.

→ SEND FOR OUR BULLETIN ←
[WE WILL BUY YOUR SURPLUS EQPT.]

HEAT & POWER CO., INC.
60 East 42nd St., New York 17, N. Y.
Murray Hill 7-5280

STEEL STORAGE TANKS
58—R.R. Type Tank Car Tanks 10,000 & 8000 Gal. Cap. Heavy Construction.
12—12,000, 15,000 & 25,000 Gal. ½ In. Horiz.

48 BALL, ROD & TUBE MILLS
10'x48", 8'x48", 8'x22", 6'x22", 6'x36", 5'x36", 3'x7', 4'x5', 4'x7', 4'x14', 5'x10', 5'x14', 5'x18', 6'x7', 6'x8', 6'x9', 6'x10', 7'x5', 7'x6', 7'x7', 8'x12', & 8'x6'.

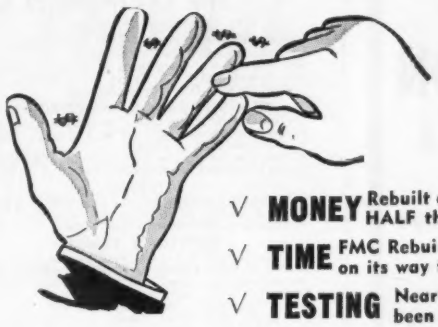
16—ROTARY DRYERS & KILNS
3'x26', 4'x20', 4'x12', 5'x35', 8'x45', 6'x50', 9'x80', 2—7'6"x55', & 4—7'x110', 8'x125', & 9'x125'.

9 AIR COMPRESSORS
676, 1302, 1578', 2200', 3678', Ingersoll Rand & Chgo Pneu 2300/440 Electric

CRANES & LOCOMOTIVES
12—125, 100, 80, 65, 44 & 10 Ton G. E. Diesel Elec. Locomotives. 10 Ton Ply. Gas
25 TON AMER. DIESEL LOCO. CRANE.

HAMMER MILLS
24 x 36 Jeffrey B2 Hammermill With 75 HP 3P 60C 440 v Motor
9 Jeffrey 42 x 36, 36 x 24 & 30 x 30
5 Universal 30 x 30, 36 x 26 & 24 x 18.

STANHOPE, 60 E. 42nd St., N. Y. 17, N. Y.



5 Ways to SAVE with FMC EQUIPMENT

THERE CAN BE ONLY 1 FIRST

√ **MONEY** Rebuilt equipment usually sells for about HALF the maker's NEW price.

√ **TIME** FMC Rebuilt equipment can be shipped and on its way to you in a few hours.

√ **TESTING** Nearly every one of these units has been tested in actual operation.

√ **PRODUCTION** To increase your output quickly and economically, add a good re-built machine to your line.

√ **ENGINEERING** One thing you DON'T pay for is the original engineering and designing put into the machine when fabricated.

COMPLETE PLANTS for the production of CO_2 (Dry Ice), Yeast, Liquors, Rubber, Oil Expelling, Solvent Extraction, Flash Drying, Pelleting-Briquetting, Printing Inks, Chemical Fertilizer, Vegetable Canning, Penicillin, Lime Calcining, Paint & Lacquer, Charcoal. Send for Details.

Pfaudler Glass Lined Jacketed Reactors; 150 gal., 400 gal., 1000 gal.
Pfaudler Stainless Jacketed Agitated Reactors; 50 gal. and 75 gal.
755 Gal. Stainless Vacuum Still, 4'6"x6' with Coils and Alum. Column 18"x15'.
Lancaster Stainless Lined Rotary Reactor; 300 PSI; Int. 50"x17'.
Struthers-Wells Stainless Vacuum Pans; 5'x12'8" with Calandria 630 sq. ft.; 200 PSI.
Zaremba INCONEL Double effect Evaporator; 60"x17' and 84"x15'6".
Porter Type 316 S.S. 30 cu. ft. Ribbon Mixer.
J. H. Day Jacketed Double Ribbon Blender; Size 30"x78"x34" with 10 HP motor.
Patterson Stainless Conical Tumbling Mixer; 64 cu. ft. with 7½ HP XPL motor.
Readco 210 gal. Jacketed Heavy Duty Double Ribbon Mixer, 30"x68".
Sprout Waldron Stainless Ribbon Mixer; Continuous Cylinder; 28"x12'.
W. & P. Type Heavy Duty Double Arm Jcktd. Mixer; 100 gal. working.
Baker Perkins 200 gal. Jacketed Double Arm Mixer; size 17; BB/V11.
Baker Perkins 300 Gal. Double Arm Sigma Blade Mixer; Size 18 DIM with 39 HP motor.
Stainless Tumbling Barrel Mixer, 5'x5'; baffled interior; 3 HP.
Simpson Intensive Muller Type Mixer, Model 'O'; 36"x15"; Jacketed.
Stainless Steel Bubble Cap Column; 16 sec.; 8⅝"x19', complete.
Aluminum Column; Bubble Cap; 60 plates; 27½" dia. x 36' high.
Dopp Cast Iron Jacketed and Agitated Kettles; 650 gal.; 61"x68".
Bethelehem Cast Iron Sulphonator; 79"x74½"; with Coils in Jacket.
Orville Simpson Rotex Sifters; 30"x60"; 60"x84"; 40"x120".
Robinson Unique Gyro Sifters; 20"x69"; 20"x86"; 40"x60".
Robinson Triple Deck Gyro Sifters; 30"x96", motorized.
Witte Stainless Steel sifters; 21"x67"; 31"x77" and 21"x10', complete.
A. O. Smith; Stainless Lined Pressure Tanks; 135 PSI; 10'x30'.
Oliver Horizontal Rotary Vacuum Filter; Pan 7' Dia.; Stainless Contacts, complete.
Baker Perkins 3SC Slurry Feeder; Screw Type; Type 316 Stainless; Motorized.
Shriver & Sperry Aluminum Filter Presses; 12", 18", 30", 36".
Shriver & Sperry Stainless Filter Presses; 12" and 18".
2 Enzinger Pressure Filters; 15 leaves in tank 48"x91", 360 sq. ft. each.
Sweetland No. 5 S.S. Lined Filter with 30 leaves on 2" Centers.
Feinc S.S. Drum Filter 5'x4' with string discharge, drive, reduction unit, motor.
A.T.&M. 30" S.S. Suspended Centrifuge, plow discharge; 20 HP.
Patterson-Columbia Separator; Type RDE; chromed and tinned contacts; 7½ HP.
A.T.&M. 42" Stainless Suspended Centrifugal; 30/15 HP.
Sharples Super-D-Hydrators; Models C20 and C27 in Stainless.
Sharples Super-D-Canter Type 316 SS; Model PN 14.
Delaval Nozzle Ejector Stainless Centrifuge or Yeast Separator.
DeLaval Centrifugals; Models 44-11 and Type 94-11; industrial AA-00 5 HP. XPL.
Bird 36"x50" Centrifugal Filter; Rubber Cov. & S.S.; 40 HP.
Bird 18"x23" Continuous Steel Centrifuge with solid conical bowl.
Bird 40"x60" Continuous Stainless Steel Centrifuge, 50 H.P.
Buflovak Stainless Clad Vac. Filter-Dryer; Jktd; 78"x58", complete.
Ross Stainless Steel Heat Exchanger; 1100 sq. ft. surface area.
American Ring Roll Pulverizer with 50 HP 3/60/220-440 V motor.
Mikro Pulverizers; Models Bantam 2SI, 2TH, 2SCB and 4F.
Raymond Imp Mills; Models 00, 0000, #32, #47 with accessories.
International type X24 Pebble Mill 8'x8' with 50 HP gearmotor.
Patterson Buhrstone Lined Pebble Mills; 5'x8'; 6'x6' and 6'x8'.
Hardinge Conical Ball Mill, 10' diameter x 48" face.
Stokes Rotary Jacketed Vacuum Dryer; 30"x10', complete.
Devine Vacuum Shelf Dryer No. 12; shelves 40"x42".
Squier Stainless Clad Rotary Atmospheric Dryer; 30"x20'.
Bagley & Sewell Double Drum Dryer; 28"x60" with Accessories.
C.E. Two Stage S.S. Flash Drying System; 1000 lbs. evap. per hour.
Raymond Flash Drying System including 6o. 47 Imp Mill, Dust Collector, Cyclones, Gas Fired Indirect Heater and accessories.
Louisville Steam Tube Dryer; 54"x40" with Cooler 38"x20'.
Rotary Jacketed Vacuum Dryer; 52"x102"; Dust Collector & access.

Send for LATEST BULLETIN for Complete STOCK LIST

FRED R. FIRSTENBERG, Pres.

FIRST MACHINERY CORP.

209-289 TENTH STREET, BROOKLYN 15, N. Y.
PARKING ON THE PREMISES *Phone: STerling 8-4672*

FINAL LIQUIDATION

BATON ROUGE, LA.

Purchased 1953
Used Less Than 30 Days

2—BUFLOVAK 6'x5'6" single drum monel Flakers. NEW.

2—I.R. Jet Refrigeration Units 208 and 136 tons.

1—ILLCO Duplex Ion Exchanger, two 5x9 316 SS Tanks with 182 cu. ft. of Dualite A-7 Resin.

1—RIETZ 30'"Thermoscrew" Conveyor Dryer 304 SS.

1—WESTERN Precipitation "Holo-Flite" jacketed Screw Conveyor Dryer 12'.

2—LINK BELT Twin Screw Conveyors 316 SS, 18"x10', 18"x72'.

3—SCHALLER 4'x13' 316 SS Reactors with tubular calandrias 513 sq. ft. each.

1—PFAUDLER 250 gal. Hastelloy "C" Reactor.

1—COLONIAL 5,000 gal. 316 SS Tank.

2—PFAUDLER 2300, 1200 gal. glass lined Tanks.

1—7500 Gal. 316 SS Hopper.

1—PATTERSON 7'6" Conical Blender, rubber lined.

2—PFAUDLER Monel Heat Exchangers 62 sq. ft. each.

9—KARBATE Heat Exchangers 370, 255, 188, 170, 160, 70 and 16.4 sq. ft.

2—KARBATE Centrifugal Pumps, Series 3A, 5 HP XP motors.

3—LAWRENCE 316 SS Vert. Centr. Pumps 70 to 350 gpm, XP motors.

4—LINK BELT 12" rubber belt Conveyors 30' to 77' cc.

Pipe, Valves & Fittings

3000 ft. 2" to 6" Saran lined pipe, fittings and 250 valves.

500 ft. 1" to 4" Stainless 316, Nickel, pipe, fittings, valves.

2000 ft. 1" to 4" Glass Lined Pyrex, Karbate pipe and fittings.

100 Lapp Porcelain valves and fittings 1" to 4".

50 Instruments, Fisher Porter Flowmeters with Hastelloy and Tantalum fittings, Foxboro Temp. Recor.

Details On Request

Your Inspection Invited

BRILL EQUIPMENT COMPANY

2401 Third Ave., New York 51, N. Y.

BIG SAVINGS IN GUARANTEED EQUIPMENT

DRYERS & KILNS

Devine #12 Vac. Shelf Dryer 40" x 42" Shelves.
1—Stokes 2' x 6' Rotary Vac. Dryer.
Gen. Amer 2' x 1' Continuous Rotary Vac Filter.
2—Albright-Neil 4' x 9' Atmos. Drum Dryers.
1—Buffalo Vac. Drum Dryer 24" x 20".

CENTRIFUGALS & CENTRIFUGES

4—Tolhurst 40" Suspended Type Centrifugals.
8—Centrifugals 12", 30", 40" & 48" Steel, Copper, Stainless & Rubber Lined.
6—Sharples Centrifuges #5A Stainless. Also #6.
3—De Laval Multiple Clarifiers #200, 300 & 301.

FILTERS

1—Vallez 41 Stainless Covered Leaf Filter, type 49.
Sperry & Shriver 12" to 36 sq., iron & wood.
Sweetland & Oliver Rotary Vac. Filters.

KETTLES & TANKS

1—Dopp 350 gal. C.I. Jack. Vac. Kettle.
Devine & Stokes Impreg. Units 30" & 36" dia.
Devine 1000 gal. closed jack. Steel Kettle.
1—2300 gal. vert. agit. jack. Steel Kettle.
8—Jacketed Kettles 50 to 25000 gals.
1—250 gal. Lead-Lined Kettle.
2—500 gal. vert. Glass Lined Tanks.
50—Stainless Alum., Copper, Glass & Lead Lined Kettles & Tanks. Also new Stainless.

PULVERIZERS & MILLS

2—Mikro Pulverizers #2TH #4TH.
Patterson 30" x 42", 4' x 5' & 6' x 4' Pebble Mills.
Abbe 30" x 30" & 30" x 36" Pebble Mills.
Abbe 37" x 30" Chrome-Mang. Ball Mill.
#1 Raymond Automatic Pulverizer 20 H.P. motor.
1—Raymond #00 Pulverizer 30 H.P. Complete.
2—#0000 Raymond Mills
Sturtevant #0, 16" Hinged Hammer Mill.
Jeffrey 18" x 18" Single Roll Crusher.
Buchanan 5" x 12" Jaw Crusher.
Hammer Mills & Pulverizers 3 to 50 H.P.
1—Schutz-O'Neil 20' Pulverizers. Also #1.
Williams #3 & 2xx Hammer Mills.
1—Robinson 18" x 22" Attrition Mills.
1—Lehman 4 Roll W.C. 12 x 36" Steel Mill.
3—Steel 3 Roll Mills 9"x32", 12"x30" & 16"x40".
1—9" x 24 3 pr. high steel Roller Mills.
3—Houchin 18"x36"; 4 Roll Granite Stone Mills.
Ball & Jewell Rotary Cutters Lab. #1 & #2.
2—U. S. & Premier 1½ H.P. Colloid Mills.

MIXERS & SCREENS

Lancaster 6' dia. Vert. Mixer 25 H.P.
Baker Perkins double arm 100, 50 #9 gals.
2—Read 50 #100 gal. double arm mixers.
Kent 3 HP. Continuous Dry Mixer.
Horiz. Mixers single & double arm to 200 gal.
3—Day 8, 15 & 40 gal. Pony Mixers.
Read 40 and 80 qt. vertical Mixers.
6—Lead & Paste Mixers 50 to 150 gals.
1—Tyler 5' x 5' Vibratory 2 Deck Screen.
Blystone 3000# horiz. spiral mixer.
10—Dry Spiral Mixers 50 to 3000#.
12—Portable Elec. Agitators ½ to 3H.P.

MISC. & SPECIAL

Kux 2½" single punch Preform Machine
Anderson & French Oil Expellers.
Gould 75 HP Centriugal Pump, 250 PSI.
Pneumatic Scale Automatic Capper M.D.
1—Marco 200 Stainless Steel Homogenizer.
2—Samco Jr. 6 spt. Vac. Bottle Fillers.
Filling Machines powder, paste & liquid.
Rotary & Single Punch Tablet Machines, ¼" to 4".
1—Howe Mogul Barrel & Bag Packer.
2—Worthington 12" x 12" x 12" Vac. Pumps.
6—Devine Stokes & Buffalo Vac. Pumps.
Soap Machinery for Toilet, Laundry, Chip, Liquid.
Plastic & Rubber Mills & Calenders.
Plastic & Rubber Hydr. Presses, Extruders & Injection Molding Equipment, Banbury Mixers.

NEW TANKS, STAINLESS & CARBON STEEL, BUILT TO YOUR SPECIFICATIONS
WE BUY YOUR SURPLUS MACHINERY & COMPLETE PLANTS
PARTIAL LISTING, WRITE FOR BULLETINS

STEIN EQUIPMENT COMPANY

107 - 8th St. Brooklyn 15, N. Y. *Sterling 8-1944* *Cable Machequip*

★ FANS
★ BLOWERS
★ EXHAUSTERS

NEW and REBUILT

Save 30% to 50% on Stock Shipments

• We can supply all leading makes of—Rotary Positive Blowers . . . Turbo Blowers . . . Centrifugal Fans . . . Steel Plate Exhausters . . . *fully guaranteed*. Whether you need 1 cu. ft. of air or 100,000 we have the blower to do it. We have had 28 years of exclusive rebuilding experience on this type of equipment.

• Send us your requirements or write for complete listings.

WM. M. MEYER & SONS, Inc.

8243 Elmwood Avenue
SKOKIE, ILLINOIS (Chicago Suburb)
Chicago Telephone—KEystone 9-8260

Surplus
STAINLESS PIPING MATERIALS

Low prices on unused stainless pipe, valves and welding fittings. Types 304L, 304, 347, 316. Stock list on request.

ANCHOR SUPPLY CO.
1742 Fourth Ave. So. Seattle 4, Wash.

All items listed subject to prior sale or use by Eli Lilly and Company.

9 Podbielniak, Type 316 S.S. centrifugal, multistage, counter-current liquid-liquid solvent extractors. 1 Serial #6060, 8 Serial #6070, Engineering data available. Original cost 1947—$12,500 ea. Used. PRICE $2,500 ea.

1 Buffalo Vac 12" x 18" Drum Drier S.S. Blade and Drum. Used. PRICE $1,500

3 Devine single door vacuum shelf driers, 6 shelves, 9" apart. 80 square feet effective pan surface. Drawing available. Replacement cost $5,500 ea. New. PRICE $2,500 ea.

1 Dean Brothers Pump 7 x 7 x 10 Duplex Double Acting Piston Type Pump. Durable S.S. Valve Service. Replacement cost $1,200. New. PRICE $600

3 Polar Stills, 3 Rotameters, 1 Tapered Tantalum condensor, 1 Copper condensor 24 square feet, 1 Tilting Kettle on casters 200 gallon.

All Items F.O.B. Indianapolis

ELI LILLY AND COMPANY

Plant Salvage Department John H. Compton
740 S. Alabama Street, Indianapolis 6, Indiana
MElrose 6-2211

JULY SPECIALS

AT&M 48" SS Centrifuge, 30 HP exp mtr.
Mikro Pulverizer #4 with 40 HP mtr.
Gen. American 42"x120" Twin Drum Dryer
Link Belt S/S Rotary Dryer, 5'x20'
Sharples Super Cent. SS, 2 HP exp. mtr.
Day 5 gallon SS Jktd Mixer, sigma arms
Day 70 cu. ft. Jktd. Spiral Mixer, 10 HP
Sperry 32"x32" Iron Filter Press
Oliver Filter 8'x8', Acid Resistant, 15 HP
Hersey 4'x30' SS Rotary Dryer

NEW—Steel & S/S Mixers, Kettles & Tanks, Fabricated To Your Specifications. Engineering Advice Available.

WE BUY COMPLETE PLANTS OR SINGLE UNITS. WHAT HAVE YOU FOR SALE OR TRADE?

YOU CAN BANK ON

EQUIPMENT CLEARING HOUSE, INC.

111 33rd Street, Brooklyn, N. Y.
SOuth 8-4451—4452—8782

Money slip Through your Fingers?

NOT WHEN YOU SAVE MONEY BY BUYING

GELB EQUIPMENT

6—Stokes Tablet Machines, Model F
7—Stainless Steel Condensers 15, 20, 30, 55, 90 and 400 sq. ft.
1—Devine Double Door Vacuum Shelf Dryer, 20 shelves (New)
1—Ames 40 HP Package Boiler, 100 PSI.
1—Ames 500 H.P. Package Boiler, 100 p.s.i.
1—Hoffman Centrifugal Blower with 20 HP Motor



THE GELB GIRL—JULY, 1955

AUTOCLAVES—KETTLES TANKS

1—Pfaudler 1,000 gal., Glasslined Jacketed Reactor, Series R. (New)
6—Pfaudler 50 gallon glass lined vacuum receivers (New).
1—Nooter steel jacketed vacuum kettle, 750 gallons.
1—Pfaudler Glass-lined Storage Tank, 1,000 gallons.
1—Patterson-Kelly Steel Jacketed Kettle, 1500 gallons, ASME.
1—Plate Fabricators 6,000 gallon Jacketed Kettle.
1—Pfaudler 150 gallon Stainless Steel Jacketed Kettle with Anchor type agitator.
1—Groen Stainless Steel Jacketed Kettle, 40 gallons, with agitator.
3—Stainless Steel Jacketed Agitated Vacuum Kettles, 650 gal.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.
1—Stainless Steel, 4000 gal. Tank.

CENTRIFUGALS

2—Sharples S.S. super pressurite contrifuges. Model 16.
2—Sharples Type 316 Stainless Steel Centrifuge, Model D2.
1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
1—Rochester, Stainless Steel, 48" susp. centrifuge, perforated basket.
1—A.T.&M., Stainless Steel, 18" susp. centrifuge, imperforated basket.
1—Ellis, Stainless Steel, 30" centrifuge.
1—Fletcher S.S. Suspended Type Centrifuge, 40" Perforated Basket.
1—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Basket.

DRYERS—KILNS

2—Buflovak Atmospheric Double Drum Dryers, 24" x 36".
1—Vulcan Rotary Kiln, 7' x 120'.
2—Buflovak single door vacuum shelf dryers, 20 shelves.
2—Devine single door vacuum shelf dryers, 10 shelves.
1—Devine laboratory vacuum shelf dryer with 3 S.S. shelves (New).
1—3' x 12' Stainless Steel Rotary Vacuum dryer.
1—Steel and Alloy 3' x 15' Heresite-lined Rotary Vacuum Dryer.
1—Stokes Rotary Vacuum Dryer, 30" x 8'.
1—Buflovak 32' x 90" Double Drum Dryer—Complete.

CONDENSERS, HEAT EXCHANGERS & COLUMNS

12—Struthers Wells S.S. heat exchangers, 650 sq. ft. each.
1—Hatfield Stainless Steel Bubble Cap Column, 6' x 16'6", 7 trays.
4—Alco Steel Heat Exchangers, 360 sq. ft. each.
3—Downington Stainless Steel Condensers, 500 sq. ft. each.

FILTERS

1—Shriver, 36", 3 eye, open delivery, washing type Filter Press with 35 chambers and Simplex hydraulic closing device.
2—Shriver 30" recessed type Filter Presses with 23 plate center feed, open delivery.
1—Sparkler Steel Filter, Model 18-4.
1—Sparkler Steel Filter, Model 18-8.
Both complete with pumps and motors.
3—Hoffmon Steel Industrial Filters, Model 20021, 1-20-S, 1-10-S.

1—No. 10 Sweetland Filter, 36 leaves
1—Oliver Rubber Lined Pressure Filter, 3' x 6'. Complete)
1—Filtration Enginners Type 316 S.S. Rotary Vac. Filter, string discharge, size 6'6" x 6'. (New)
1—Filtration Engineers Type 304 S.S. Rotary Vac. Filters, string discharge, 3' x 3'. (New)

FILTERS (Cont'd)

1—Shriver C.I. Plate and Frame, 2 eye, open delivery Filter Press 42" x 42", 54 chambers.
1—Sperry 3-eye, closed delivery, cast iron. Plate and frame Filter Press, 9 ch., 30" x 30".
1—Sperry Wooden Plate and Frame Filter Press, 12" x 12", 15 chambers.

MIXERS

1—Banbury Mixer, midget size with 2 HP motor.
1—International S.S. Double Ribbon Bender, 50 cu. ft.
4—Lightnin' Side Entering Mixers, 20 HP, explosion-proof 425 RPM.
1—Baker Perkins Steel Double Arm, Sigma Blade Mixer, 20 gal.
1—Day Stainless Steel Double Arm Jacketed Sigma Blade Mixer, 50 gal.
1—Struthers Wells Northmaster vacuum mixer, dispersion blades.
6—Simpson Intensive Mixers #0 and #1.
1—Read 10 gallon Stainless Steel Double Arm Sigma Blade Jacketed Mixer, with vacuum cover.

Established 1856

R. GELB & SONS, Inc.,

CHEMICAL, RUBBER, OIL, PLASTIC and FOOD PROCESSING MACHINERY

U.S. HIGHWAY No. 22, UNION, N.J. · MUrdock 6-4900

HERE THEY ARE

2—8'x125' Rotary Kilns.
3—6'6"x50' D. H. Rot. Dryers, ⅝".
1—#2 Simpson Mixer, motor drive.
2—54"x70" and 1—40"x60" Bird Continuous Centrifugals, S/S Solid bowls.
4—S/S Merco C-30 Centrifugal Separators, ea. with 100 HP TEFC motors & controls.
2—S/S Hersey Rotary Dryers, 5x26' and 6/ 23'.
1—#502-16 Link Belt S/S Roto-Louvre Dryer.
2—3'x50' Bonnet D. H. Rotary Dryers & Coolers.
3—6'6"x50' D. H. Rot. Dryers.
3—Unused #12 Sweetland Filters, 48 bronze Monel covered lvs. 3" cc.
1—50 gal. Stainless 347, Calandria Still, Agitated, with Condenser.
1—50 gal. Stainless 347, Agitated Tank, Motor Driven.
1—Sharples #C27 Super Dehydrator, S.S.
9—Sperry 18"x18" iron recessed Filter Presses, 18 chambers.
3—450 gal. S.S. Steam jktd. Kettles.
1—Buflovak 48"x40" Drum Flaker, chrome plated, S/S ends.
1—Oliver Rotary Acid Filter, 6'x6'.
4—Mojonnier, S.S. Vac. Pans, 3', 5', 6'.
3—6'x50' L'ville Rot. Tube Dryers.
1—Day size 30 Imperial Jacketed 75 gal., Sigma Blades.
1—2TH, Mikro Pulverizer.
4—Buflovak Atmo. Dbl. Drum Dryers 24"x36", 32"x90", 42"x120".
3—Anco 4'x9' Chilling Rolls.
5—Horiz. Ribbon Dry Mixers, 4000 lb., 1500 lb., 500 lb.

Only a Partial Listing

Wanted: Your Idle Machines or Plants
Send List Today

Our 38th Year

CONSOLIDATED
PRODUCTS COMPANY, INC.
154 Observer Highway
HOBOKEN, NEW JERSEY
Tel.: HO 3-4425 N. Y. Tel.: BA 7-0600

PIECEMEAL LIQUIDATION

1—Bird 24" #CH-208 Contin. Horiz. Centrifuge
1—Fletcher Susp. Centrifugal 40" perf. steel basket, bottom discharge
1—Sweetland #10 Filter, 27 lvs.
1—Sweetland #5 Filter, 27 lvs.
2—Struthers Wells Rotary Kilns 7' dia. x 64'6" long x ⅜"
2—Struthers Wells Rotary Kilns 7' dia. x 59'6' long x 9/16"
2—Ruggles Coles Rotary Dryers, 3' x 24'; 4'6' x 40'
2—Shepard-Niles 4-ton Monorail Cranes with motors
1—Link-Belt Skip Hoist, 4800# cap., 43' lift
1—Munning Plating Generator Set. 50 HP. 31.5 KW. 4500 amp., 7V.

Our Mr. Betz on premises—

Mutual Chemical Co. plant
201 West Side Ave., Jersey City, N. J.
(Phone Henderson 3-2161)

LIQUIDATION BY
PERRY EQUIPMENT CORP.
1413 N. 6th St. Phila. 22, Pa.

FOR SALE

64" dia. x 13 plates Chrome Iron Column
Cube Blender 6'-6" x 6'-6" S.S. type 316 #4 finish
Hardinge Pebble Mill 8' x 48", 800 gallon
Stedman Type BX 20 by 12 Swing Hammer Grinder
Baker Perkins #14 JEM jkt. Vacuum Double Naben Mixer
Sperry 36"-39 chambers Heated Filter Press
Tolhurst 26" S.S. Type 316 Suspended Centrifuge
20 cu. ft. S.S.-304 Powder Blender.
Sparkler 18-8-18 Steel Filter
Niagara Filter Model 95-36 Vertical
42" Mojonnier S.S. Vacuum Pan
48" Rogers S.S. Vacuum Pan
5-1250 gal. S.S.-304 Sanitary Tanks
6000 gal. S.S.-304 Sanitary Insulated Tank
5500 gal. Glass Lined Insulated Tank.

BEST EQUIPMENT COMPANY
617 Davis St. Evanston, Illinois
DAvis 8-0926

FOR SALE

W&P 100 GAL WC MIXERS
B&P LAB 2¼ gal MIXERS new
ROBINSON 1500# S/S RIBBON MIXER
LIGHTNIN 3HP PORT AGIT new
SPARKLER S/S FILTER 33D17
PATTERSON 5x6 JACKETED STEEL BALL MILL
PATTERSON 4x5 BUHRSTONE PEBBLE MILLS
BUFLOVAK DOUBLE DRUM DRYER 32" x 52"
MIKRO 2DH TANDEM PULVERIZERS
MIKRO 3TH PULVERIZER
SPERRY 12" P&F NICKEL FILTER PRESS
OTHER P&F and recessed plate FILTER PRESSES in stock
100 S/S KETTLES from 2¼ to 125 Gal
S/S OR PLAIN STEEL TANKS IN STOCK

We buy one item to complete plant—additional equipment in stock.

Send Us Your Inquiries

AARON Equipment Company
1347 So. Ashland Ave., Chicago 8, Illinois
PHONE: CHesapeake 3-5300

SAVINGS IN NEW AND USED
PROCESS EQUIPMENT
For Laboratory and Production
HIGH SPEED STONE MILLS
PEBBLE MILLS; Large Selection
COLLOID AND ROLLER MILLS, AGITATORS MIXERS, CRUSHERS, FILTERS, STRAINERS CENTRIFUGES, PUMPS, TANKS, KETTLES HOISTS, EX. PR. LIGHTS AND GENERAL PAINT FACTORY SUPPLIES OF ALL TYPES
SPOT LOTS OF RAW MATERIALS TO BUY OR SELL— *TRY*
GENERAL TRADERS, Inc.
2627 Grand Ave. Chicago 12, Ill.
PH: ARmitage 6-8050

Your Inquiries to Advertisers Will Have Special Value . . .

—for you—the advertiser—and the publisher, if you mention this publication. Advertisers value highly this evidence of the publication you read. Satisfied advertisers enable the publishers to secure more advertisers and—more advertisers mean more information on more products or better service—more value—to YOU.

At Your Service

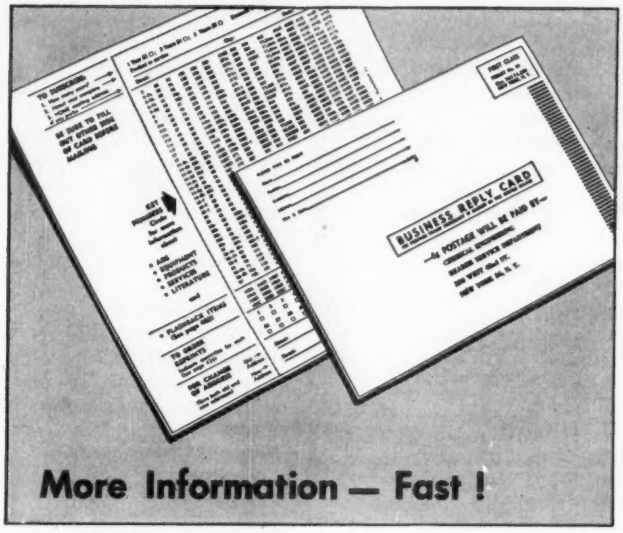
—for bringing business needs or "opportunities" to the attention of men associated in executive, management, sales and responsible technical, engineering and operating capacities with the industries served by the following McGraw-Hill publications:

The CLASSIFIED ADVERTISING SECTIONS of

American Machinist
Aviation Week
Business Week
Bus Transportation
Chemical Engineering
Chemical Week
Coal Age
Construction Methods & Equipment
Control Engineering
Electrical Construction & Maintenance
Electrical Merchandising
Electrical Wholesaling
Electrical World
Electronics
Engineering and Mining Journal
E. & M. J. Metals & Mineral Markets
Engineering News-Record
Factory Management and Maintenance
Fleet Owner
Food Engineering
National Petroleum News
Nucleonics
Petroleum Processing
Petroleum Week
Power
Product Engineering
Textile World

For advertising rates or other information address the
Classified Advertising Division
McGRAW-HILL PUBLISHING CO., Inc.
330 West 42nd Street
New York 36, N. Y.

READER SERVICE



INDEX TO CHEMICALS & EQUIPMENT

Chemicals and materials **412**
Equipment and accessories **413**
Processes and services **420**
Flashback: Last month's new products **421**

GUIDE TO TECHNICAL LITERATURE

Chemicals and materials **422**
Construction materials **429**
Electrical equipment **430**
Handling and packaging **434**
Heating and cooling **435**
Instruments and controls **437**
Mechanical equipment **430**
Pipe, fittings, valves **440**
Process equipment **443**
Pumps, blowers, compressors **448**
Services and processes **451**

INDEX TO ADVERTISERS

Alphabetical list of firms in this issue **452**

CHECK LIST OF REPRINTS

Editorial reports now available **458**

READER SERVICE POSTCARDS

Get more information—fast ..... **Inside Cover**

Quick way to keep posted.

Now it's easy. Just use CE's new directory of products, equipment and services. It's a complete, finger-tip reference to each month's advertised items and new product developments. (p. 412)

Now—yours for the asking.

You can now get—free and fast—the latest literature on any topic in your field. Our comprehensive checklist can help you keep your technical files up-to date. (p. 422)

Who's offering what today.

Every month you'll find industry's most progressive firms among CE's ad pages. You can use our index of advertisers to check up on what they're offering that will help you. (p. 452)

For more information—fast!

That's where Reader Service postcards come in. They're easy to use, bring quick results. Try one out today. (Inside Cover)

Index to Chemicals & Equipment

What It Contains . . .

Here's your complete index to the chemicals, materials, equipment and services advertised in this issue, announced in the Chemicals & Raw Materials and Process Equipment News departments, or listed in this issue's Guide to Technical Literature.

What the Code Means . . .

Each item has a code that's the key to its location in this issue. The numerals show the page where you'll find the item mentioned. The letters L (left), R (right), T (top), B (bottom) locate ad postions on the page; the letters a, b, c and A, B, C identify items on a page or in an ad.

For More Information . . .

You can get more information on any product listed in this directory by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, then mail to us. Answers will come to you direct from the companies manufacturing the products.

Contents of This Section . .

Products in this Index are categorized as follows:

	Page
Chemicals & materials	412
Equipment & accessories	413
Processes & services	420
Checklists of last month's new products	421

Find it tough to keep up with chemical products and equipment? You can use this master index as a quick way to spot exactly what's in each issue on any particular item.

Chemicals

Acetate, flame resistant....96b
Acetic anhydride....422B
Acetoacetarylamides....422C
Acetone, catalog SC 54-40....119
Acetylene....422D
Acid
  Butyric, N-coco B-amino....422E
  N-Butyric....422F
  Cresylic....422G
  Isosebacic....35-6a, 146A
  Muriatic....422H
  Oleic....422I
  Peracetic....422J
Acid salts, acetic....422A
Acrylic paint....140A
Alcohol, furfuryl....422K
Alcohols....422L
  Fatty....422M
Alkyl benzyl triethyl ammonium chloride....422O
Alumina
  Activated....147
  Calcined, metallurgical grade.422P
Amines, tertiary....422Q
p-Aminophenol....422R
Ammonia....111a
Ammonium molybdate....422S
Antioxidants....422T, 423A
Biphenyl, chlorinated....423B
Bleaching, pulp....423C
Butyl oleate....423D
2-Butyne-1, 4-diol....423E
Calcium hydride....423F
Carbon
  Activated....423G, 423H, 423I
Carbon dioxide....76, R449
Catalysts
  Bulletin G-260....343
  Low-density, petroleum cracking....148F
Chemical processing materials...96d
Chemicals....79, 375, 423J, 423K, 423L
  Cellulose....96a
  Chromium....424A
  Fatty....424B
  Fermentation....148A
  Industrial....101, 111b
  Peroxygen....424C
  Petroleum....271
  Resin emulsions....424D
  Synthetic organic....424E
Chloromethanes....145a
Defoamers, silicone....R447
Detergents....424F, 424G
  Non-ionic....148J
2, 6-Di-ter-Butylphenol....424H
Dibutyl phthalate....424I
Dicalcium phosphate....424J
Diethylene glycol monobutyl ether....424K
Diethylene glycol monoethyl ether acetate....424L
Diisocyanates....424N
Dimethyl itaconate & dibutyl itaconate....424M
Dimethylamino propylamine & diethylamino propylamine.424O
Dioctyl phthalate....424P
Dispersion agents....424Q
Dyes, acetate....148C
Elastomers, acrylate-type....148D
Esters....424R
Ethyl bromide....424S
Ethyl vanillin....424T
Ethylene cyanohydrin....424U
Ethylene diamine....424V
Ethylene oxide....424W
Fillers....424X
Formaldehyde....151
Glycerine....379
Glycols....424Y
Herbicides....424Z
Hydrogen peroxide solutions..424AA
p-Hydroxybenzoic acid, esters....143
Intermediates....424BB
Latex, vinyl acetate resin....424CC
Lignin....424DD
Lignosulfonates....424EE
Lithium....68, 424FF
Lithium aluminum hydride..424GG
Lubricants....424HH, 424II
Methyl chloride....145b
Methylcellulose....424JJ
Molybdenum....424KK
Musk, synthetic....148B
Nitrogen compounds, aliphatic.422N
Nitroparaffins....425A
Oils
  Hydrocarbon....425B
  Leakproof....281
  Rust inhibitor....148H
  Sperm....425C
Phenol....425D
Phthalic anhydride....425E
Plasticizers..425F, 425G, 425H, 425I
Polyethylene....144B
  Emulsifiable....269
Polyvinyl acetate beads....425J
Polyvinyl acetate emulsions....425K
Polyvinyl materials....9
Powders, diatomite....141
Preservatives....425L
Propylene Glycol....426A
Reagents....426B, 426C
Refractory, thin silicone carbide.148G
Reodorants....426D
Resin dispersions....426E
Resins....364, 426F, 426G
  Acrylic....133a
  Casting....426H
  High styrene....426I
  Industrial....426J
  Laminating....426K
  Nylon....133b

Polyethylene....35-6b, 133c, 427A
Synthetic 96c
Tetrafluoroethylene 133d
Rosin 427B
Salt tablets, impregnated.....427C
Salts, tetrazolium 427D
Silica, colloidal 427E
Silica gel
Bulletin 201 91
Pre-attrited type 144A
Silicones spraying 146B
Soda ash 12
Sodium chromate tetrahydrate..427F
Sodium dispersions 427G
Sodium hydride 427H
Sodium molybdate 427I
Sodium sulfonates 427J
Sodium, metallic 35-6c
Solvents 428A, 428B
Stabilizers 428C
Starches 428D
Stimulants, oil-well 428E
Styrene molding materials.....428F
Sulfur, crude 153
Sulfuric anhydride, stabilized....109
Surface active agents.....428G
Surfactants, non-ionic 428H
Tolylene di-isocyanate 428I
Triethyl-o-formate 428J
2, 4, 7-Trinitrofluorenone.....428K
Tris (hydroxymethyl) aminomethane 428L
N-Vinyl-2-pyrrolidone 428M
Wax removers 429A
Waxes, petroleum 429B

Equipment

Absorbers, catalog S-7460.....49f
Adhesives 429C, 429D
Resin emulsion 429E
Agitating equipment 443C
Agitators 280C, 332b
Side drive 443D
Turbine & slow speed, bulletin 76 .....279a
Air conditioning method, controlled humidity 455
Alloys 257
Fabricated 429F
Hard-facing 429G
Nickel-base 72
Stainless 78e
Aluminum 82
Amplifiers 415b
Analyzers
Gas 92
Infrared 284B
Portable, oxygen 284A
Bag closers R433, 434B
Bags, multiwall.....387, 454
Bearings, motor, bulletin 51B7225.98
Belts, v-.....81
Blenders, bulletin 800.....354
Dry & ribbon mixers, bulletin 78 .....279b
Blowers 344
Rotary, positive 448A
Blower & Exhausters.....429b
Boilers 435I
Automatic, packaged, bulletin 1220 97

check this list

if you have any of the following filtration problems:

- ☐ Lack of clarity
- ☐ Pollution and disposal of filter cake
- ☐ Need for "sparkle"
- ☐ Unstable pre-coat
- ☐ Uneconomical volume of clarified filtrate
- ☐ Loss of cake due to pressure drop
- ☐ "Bleeding" of filter aid
- ☐ Abrasion of pumps, valves, etc.
- ☐ Too much retention of filtrate in filter cake

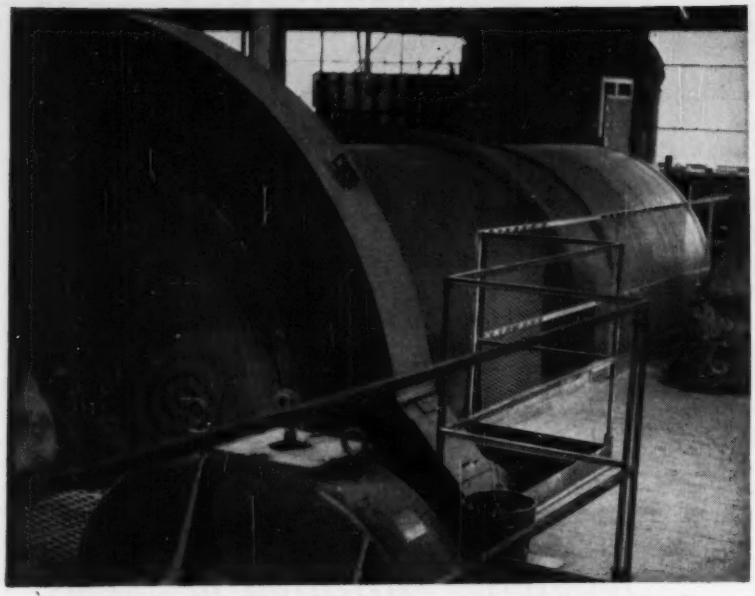
SOLKA-FLOC as a filter aid can help you solve them.

Mail this check list to Dept. FD-7, our Boston office, for samples and complete information.

BROWN COMPANY
Berlin, New Hampshire

General Sales Office: 150 Causeway Street, Boston 14, Mass.

SOLKA PULPS • SOLKA-FLOC • NIBROC PAPERS • NIBROC TOWELS • NIBROC KOWTOWLS • NIBROC TOILET TISSUE • BERMICO SEWER PIPE AND CONDUIT ONCO INSOLES • CHEMICALS



Hardinge 9′ x 22′ Pebble Tube Mill in an Ohio plant producing silica flour.

Hardinge TUBE MILLS...

... for wet grinding

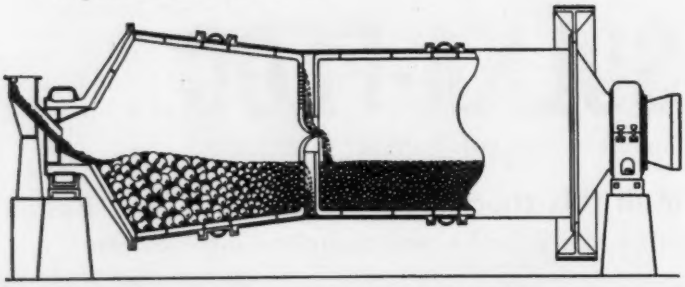
(in water or acid pulps)

Titanium Pigments
Manganese Dioxide
Diatomaceous Earth
Limestone

... for *dry* grinding

Fillers
Silica Flour
Gypsum
Carbon Black
Pigments
Cement materials

Regardless of the requirements, Hardinge Tube Mills are designed to meet specific needs. Available from 2 to 10 feet in diameter; 6 to 35 feet in length; single or multiple compartments; with acid proof lining of rubber, silica and porcelain. Complete specifications on request. Bulletin 18–B–11



Tricone compartment Tube Mill with grate and lifters.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA · 240 Arch St. · Main Office and Works

New York · Toronto · Chicago · Hibbing · Houston · Salt Lake City · San Francisco

PRODUCT INDEX . . .

Borescopes TL353
Breakers, paving 241d
Cables, aerial 287
Calcium chloride handling....434C
Casters & roll wheels.....L451
Castings, high alloy, bulletin 3354-G 336
Centrifugals, suspended 11a
Cleaners, tube 85k
Coatings, protective..168, 247, 261, 429H, 429I, 429J, 430A, 430B, 444
  Bulletin MC-9 .....382a
  Bulletin VP-1 .....382b
  Odorless 430C
  Zinc 311
Compressors 85i
  Bulletin 766 64
  Balanced-opposed 24
    Bulletin 679-B1 22-3
  Carbon piston, bulletin CRC-10 .....241a
  Centrifugal 292
  Portable 241b
  Rotary, bulletin C-5A.....384
  Spiraxial 429f
  Two-stage 378
Computors 415c
Condensers 85h
  Evaporative 282A, 435J
Conduit, electrical 430H
Connectors, bulletin TMI-455..152
Control systems, automatic...262-3a 284D
Controls 415d
  Coordinated, catalog 5002....94-5
  Level limit 333a
  Liquid level, bulletin F-3.....239
  Temperature 437, 437B
    Bulletin MC122 .....66a
    Bulletin MC123 .....66b
Conveyors systems 356
Conveyors 428
  Gravity & power 434D
  Multi-tier 443
Coolers 435K
  Cascade, catalog S-6820.....49e
  Rotary, water & air.....BL433c
Coolers & slakers 29d
Copper sheets 77
Crushers 367b
  Gyratory, primary 29e
  Gyratory, secondary 29f
  Jaw, bulletin 1124.....29c
  Rotary fine 166
Crystallizers, bulletin C-100....273a
Dampers, slide 282D
Dehydrators, crystal, bulletin 1257 135
Demineralizers, permanent cartridge 444A
Discs, rupture 337
Dissociators, ammonia, bulletin B-52 313
Drills, utility 241c
Drives 432A
  Agitator 280A
  Control, spec. CA040 83
  Electric motor 463

Shaft mounted 317
Silent chain, book 2425.....63
Variable speed, bulletin S580-5-55 .....415a
Dryers
Centrifugal 11b
Continuous, conveyor, bulletin 390 418
Lectrodryer 47
Rotary 368
Hot air, catalog A.....BL433a
Single drum 282E
Spray, bulletin D-105 & D-106 .....273b
Vacuum, bulletin 640.....359
Drying accessories, flash, catalog 54-A 326
Dust collectors
Cloth flat bag.....334, 430
Water wash, bulletins 551 & 610 .....BL349
Ejectors 85g
Elbows, long tangent, catalog 54..309
Electrical systems.....37-40b
Enamels, porcelain 377
Engines
Diesel 380
Power 290B
Evaporators, bulletin E-100....273c
Expanders, tube 432B
Fabrications
Alloy TL441
Aluminum BR395
Metal 438
Process equipment 332a
Fabrics, filter 156
Fans
Axial flow, bulletin 3533-EF...84
Grinding & mulling, bulletin 5-A 279f
Stack & duct boosters, bulletin 109-A 279-j
Feeder-conveyor-elevator unit, book 2475 13
Feeders 99b,434E
Apron & grizzley.....29g
Filters aids 251, 413
Filter cloth BL395
Filters 18
Bulletin F-101 .....273d
Continuous pressure 365
Horizontal, catalog NC-1-53...324
Vacuum 444B
Pressure 6, 280D
Process 341
Scraper discharge 331
Small 278B
String discharge 330
Fire extinguishing systems, pressure-operated CO_2.....328
Fire protection systems.....306
Fittings
Pipe, stainless steel, catalog 653 .....R357a
Rubber & Pastic.....231b
Stainless steel 78c,286A
Bulletin Q100 .....78b
Bulletin 1055 301
Welding 10
Flange specifications R357b
Fuses, silver-plated 290D

AFFILIATE OF GENERAL CERAMICS CORPORATION

Magnetic Amplifiers · INC

—announces its new

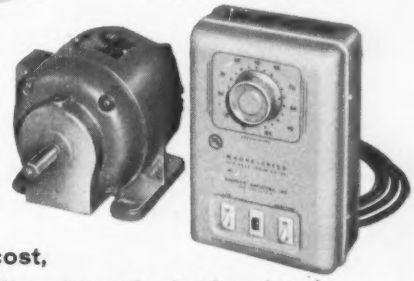
VARIABLE SPEED DRIVE

MAGNE-SPEED*



SIZE II — 3/4, 1 and 1-1/2 HP

SIZE I — 1/4, 1/3 and 1/2 HP



Stepless, instant starting, compact, 50:1 speed range, good regulation without tachometer, long life, virtually maintenance free service, low cost, fast response, reversibility, dynamic brake, local or remote control. Write for Bulletin S580-5-55.

Other MA Products and Services

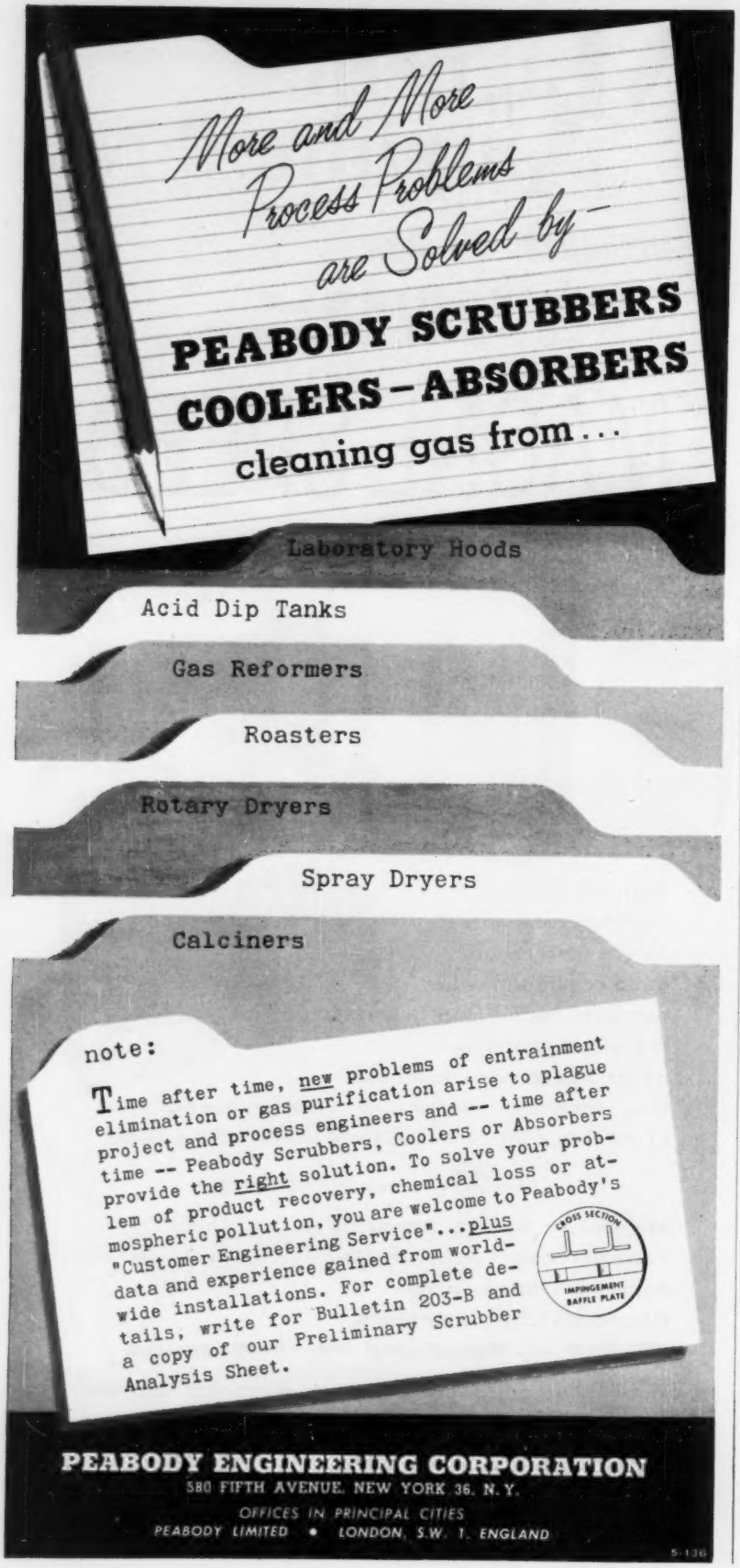
Magnetic Servo Amplifiers
Transi-Mag * Amplifiers
Analog Computors
Photoelectric Controls
DC and AC Regulated Power Supplies

* Trade Name

Application engineering and conversion of tool machines and production processes to automatic control.

Magnetic Amplifiers • Inc

Tel. CYpress 2-6610 • 632 TINTON AVE., NEW YORK 55, N. Y.



PRODUCT INDEX . . .

Gages 48, 437C
Catalog G-2 358
Beta 438A
High pressure R353
Recorders, testing instruments 438B
Tank TL-395
Gaskets
Heat exchanger 370
Teflon R441b
Generators 85e
Gas 338
Inert gas 429e
Turbine 85b
Gratings & stair treads, stainless steel 440
Hammers, jack.....241e
Heads, reflux, automatic.....278C
Heat exchangers....60-la, 89, 332c, 419, 436A
Catalog S-6740 .....49c
Catalog S-6840 .....49d
Fin-tube 282C
Immersion 436B
Internal 50-1c
Plate 131
Scraped surface, bulletin PE-1 56
Shell & tube.....383
Impervious graphite 32-3
Tapered fin 426
Heat transfer apparatus....2, 278A, 282B
Bulletin HT-1 65
Bulletin 1400 164
Heaters
Deaerating 85f
Gradiation 160
Immersion 436C, 436D
Radiant 437A
Hoists, air 241f
Impactors 99c
Indicators
Bin level.....TL447
Continuous level 333b
Instruments, spectrometer 267
Insulation 265
High temperature.....362a
Industrial 362b
Jacketing, aluminum 150
Joints, expansion 440E
Kettles 332d
Jacketed grease, catalog 356-R..46
Lab 346
Kilns, rotary, bulletin 1115.....29a
Knife cutter 367a
Laboratory & pilot plant equipment, bulletin 77-A.....279k
Linings, silicon carbide.....59
Lighting systems 290C
Explosion-proof 171
Loading assemblies, catalog F-7...25
Materials of construction, clad steel 373a
Materials handling
Bulk TL351
Bulletin 529 123
Metals, clad 276A
Meters TL449
Bulletin 2448-G R349

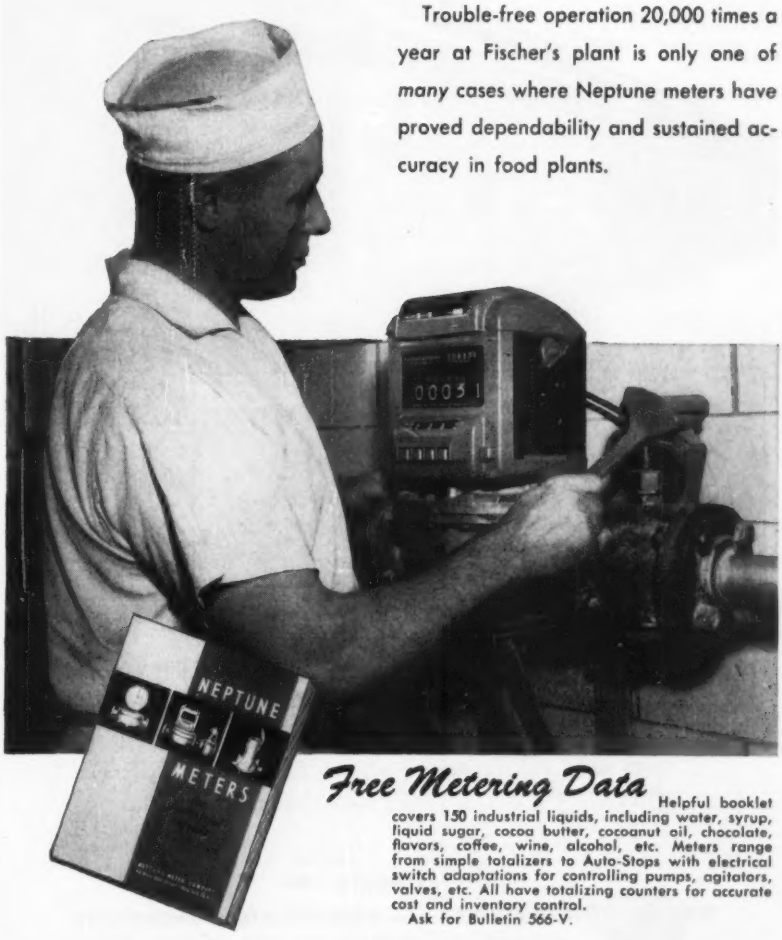
Automatic, bulletin 566-V....417
Electricontrol, bulletin 35....345
Flow 284C
Industrial, bulletin OG406....393
Positive displacement 429c
Mills
Attrition 367c
Ball, bulletin B2-B13 .....420b
Ball & pebble, bulletin 100..279h
Colloid BR396
Grinding, bulletin 8121.....29b
Hammer 367d
Reversible 99a
Helix-seal 99d
Roller 99e
Tube, bulletin 18-B-11.....414
Mixers 170, 332e
Catalog B-109 .....121f
Data B-107 .....121a
Continuous, bulletin A.....279i
Laboratory, catalogs DH-50 & DH-51 .....121g
Pipe line 446A
Portable, bulletin 74-A 279c
Catalog B-108.....121h
Side entering, bulletin 72-A..279d
Catalog B-104 .....121b
Top entering, bulletin 73....279e
Propeller type, catalog B-103 .....121c
Turbine & paddle type, catalog B-102 .....121d
Mixing & extruding machinery, bulletin 62-A 279g
Motor & starter combinations, increment 62
Motors..85d, R351, 363, 432C, 432D
Bulletin B-2401 34
Chemical 85a
Totally-enclosed, fan cooled, bulletin C2-3379 253
Weather-resistant 74-5
Nozzles, spray, catalog 24....TR396
Nylon fiber 148E
Oilers, airline 241h
Packings
Chemical 436
Mechanical 432E
Pump 442
Saddle, bulletin S-29 102
Teflon, catalog TP-1053.....329
Packings & seal cages, teflon..R441a
Pails, flaring 19
Paper, filter 446
Pen & ink, recording 57
Pipe & Fittings
Catalog S-7000.....49b
Glass, bulletins EA-1, EA-3.254-5a
Plastic 286D
Pine installation, glass, bulletin PE-3 .....254-5b
Pipe & Tubing, rubber & plastic 231a
Pipes
Bonding process 125
Plastic TR431
Saran lined 90
Shower 442A
Piping 332f, BL441

Push Button Quality Control

20,000 Batches a Year!

For closer, *automatic* control over cake and pastry sweeteners, Fischer Baking Co. switched their Asbury Park plant to liquid sugar . . . with accurate measurement provided by this Neptune Auto-Stop meter. Every 15 minutes the baker pushes buttons to set the pounds required, and opens the valve. The meter follows through . . . shuts off automatically at the right pound. Big savings are reported in time and labor. No more carting, piling, scaling, and dumping of granulated sugar. It's neater, too, because the sugar stays *inside* pipes and tanks all the way.

Trouble-free operation 20,000 times a year at Fischer's plant is only one of *many* cases where Neptune meters have proved dependability and sustained accuracy in food plants.



Free Metering Data Helpful booklet covers 150 industrial liquids, including water, syrup, liquid sugar, cocoa butter, cocoanut oil, chocolate, flavors, coffee, wine, alcohol, etc. Meters range from simple totalizers to Auto-Stops with electrical switch adaptations for controlling pumps, agitators, valves, etc. All have totalizing counters for accurate cost and inventory control.
Ask for Bulletin 566-V.

NEPTUNE METER COMPANY
19 West 50th Street, New York 20, N. Y.

Branches in:
ATLANTA • BOSTON • CHICAGO • DALLAS • DENVER
NO. KANSAS CITY, MO. • LOS ANGELES • LOUISVILLE
PORTLAND, ORE. • SAN FRANCISCO

In Canada: NEPTUNE METERS LTD., TORONTO 14, ONTARIO

neptune

More Profits

through

Proctor Drying Ranges

- Newest Pre-forming Techniques
- Improved Air Distribution
- Faster, More Uniform Drying
- Flexibility of Operation
- Guaranteed Product Quality



PROCTOR CONTINUOUS CONVEYOR DRYER
AT NATIONAL YEAST COMPANY

Yeast requires sensitive drying methods. This Proctor & Schwartz installation at National Yeast Company maintains the uniform quality, color, and viability of the yeast at considerably increased drying rates.

Proctor equipment provides the control and flexibility essential to profitable drying performance. Many wet-solid materials heretofore unsuited to conveyor drying can now be handled with speed and efficiency. And, as with all Proctor equipment, guarantee *is in terms of finished product produced.*

WRITE FOR BULLETIN # 390

PROCTOR DRYING EQUIPMENT — WRITE FOR DETAILED INFORMATION

- Tray Dryers
- Truck Dryers
- Pre-forming Feeds
- Continuous Conveyor Systems
- Spray Dryers

PROCTOR & SCHWARTZ, Inc.

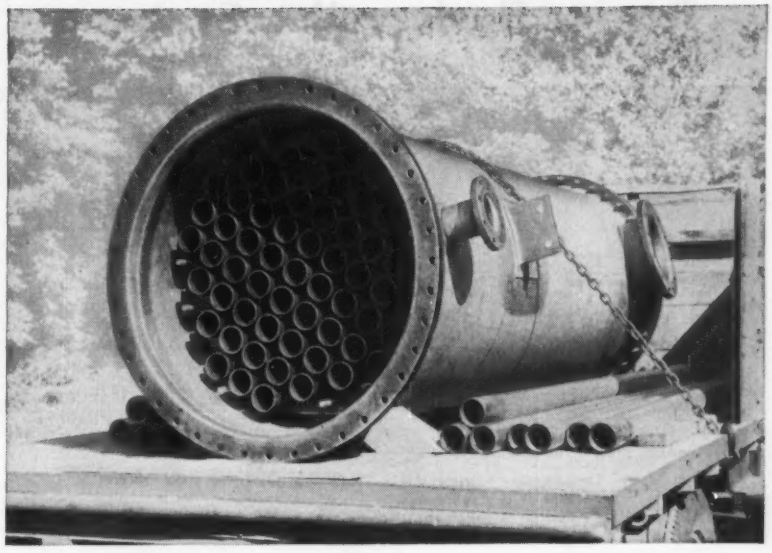
Manufacturers of Industrial Drying Equipment and Textile Machinery

Philadelphia 20, Pa.

PRODUCT INDEX . . .

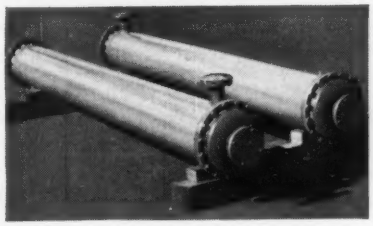
Plastics 43, 430D
Kel-f 249
Laminated & molded.....430E
Reinforced 430F
Platecoils, bulletin P61.....44
Precipitators, electrostatic 67
Preheaters, air 283
Presses, continuous, dewatering BL433b
Primers 430G
Process equipment 446B
Impervious graphite 49g
Process system, bulletin 25C6177J 319
Proportioning systems, automatic, bulletin 0351 272
Pumps 259, TR395
Catalog S-7256 .....49a
Catalog 5206 .....BR431
Data 65 .....374a
Acid 235
Canned Motor 286C
Centrifugal 456
Chemical, bulletins W-350, B14A, W-350, B18.....20-1
Sealess, bulletin 1010.....376
Single stage, bulletin 1002..314
Chemical, bulletin 52B7638....54
Bulletin 7095-A 157
Proportioning 105
Constant stroke, data 64, 64A, 64B 374b
Controlled volume....450A, 450B
Diaphragm 450C
Bulletin 137 .....BL447
Fire 71
Gas 429a
High vacuum 165
Piston-diaphragm, controlled-volume, bulletin 440.....149
Polyethylene 78d
Rotary 450D
Rotary hand 450E
Rubber lined, bulletin P9-B8.420e
Rubber & plastic.....231c
Slurry, bulletin 181.....425
Sump 241g
Bulletin 963 335
Vacuum 429d
Rayon fiber, industrial.....148I
Reactors 60-1c
Reclamation systems 420a
Recorder-controllers 333c
Recorders
Temperature TR355, 421
Recording systems
Automatic 262-3b
Oscillographic 360
Regeneration units, sludge acid..303
Regulators
Pressure, catalog 200 .....R450
Temperature, bulletin T-101 .....TL433
Rerollers, drum . 288B
Rims, sprockets, adjustable....BR439
Rotchet, non-reverse.....290A
Samplers, pipe-line.....280B
Scales BR355
Scanners, indicating.....284E

Screens
Vibrating 99f
Bulletin 53-B11 .....420f
Scrubbers, coolers-absorbers, bulletin 203B.....416
Seals
Lubricated 290E
Mechanical 352
Bulletin MS-954.....340
Rotary, bulletin B-111.....121e
Shaft, bulletin 10.....350
Seals & stuffing boxes.....464b
Separation equipment, solids, liquid 11c
Separators
Air 99g
Magnetic 237, 423,435A
Bulletin 16-E.....L439
Specific gravity L431
Silicon carbide shapes.....274A
Spectrophotometers, bulletin GEC-307 167
Spray-stops 451F
Steels
Alloy 154-5
Clad 373b
Nickel & monel clad, bulletin T-29 80
Oxygen process 88
Stainless 361
Stills 332g
Storage systems, slurry, soda ash..435B
Strainers 851
Stuffing boxes, pump, bulletin S-147 .....R451
Tank cars
Chemical shipping 87
Flued dome 73
Tanks 332h
High pressure storage.....304
Telemetering systems, automatic 262-3c
Telephones, portable.....288C
Thermometers, dial indicating & recording.....440A
Thermometers & temperature indicators 440B
Thickeners, spiral rake, bulletin T5-B5 .....420c
Towers 332i
Trailers, gas supply.....TR439
Transformers, dry-type.....434A
Trays & bubble caps.....432
Trucks
Fork 435C, 435D
Fork lift 435E
Hand 435F
Industrial 435G, 435H
Tube bundle pushers.....288A
Tubes
Alloy, copper base.....242-3
Condenser 53
Cupro-nickel 295
Porous, seamless 315
Water, copper 169
Tubing
Nylon 286B
Stainless steel 371
Turbines 85c
High speed, mechanical drive..233
Steam, bulletin S-116.....42

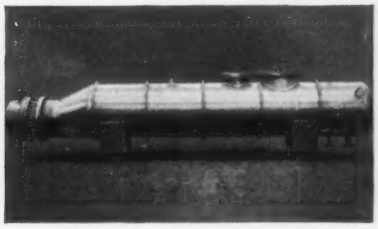


Special heat exchanger materials are well known at Downingtown!

Enamel-Lined Tubes. This stainless steel heat exchanger, with enamel-lined tubes, solved a serious set of problems which included high temperatures . . . heavy corrosion . . . intermittent operation . . . and a tight budget. It now operates at 150% of design capacity, at a temperature of 1200° F.—and the owner reports trouble-free service from his Downingtown unit. Dimensions: 28″ diameter x 10′ 0″ long. Stainless steel shell. Tubes: 3½″ O.D., lined with high temperature enamel.



Ampco 8—Downingtown engineered these two fixed tube sheet benzene condensers for export. Process conditions required copper alloy tube sheets, yet the customer did not want a gasketed joint between tube sheets and shell flanges. So we welded the Ampco 8 tube sheets directly to the steel shells, thus saving the cost of alloy shells. Dimensions: 14″ diameter x 12′0″ long. Eighty copper tubes, 1″ O.D. x 14 gauge. Ampco 8 tube sheets ⅞″ thick. Ampco 8 heads ⅜″ thick. Design pressure is 75 psi on shell and tube sides.



Solid Nickel—This solid nickel reboiler for vacuum service—one of eight identical units fabricated for one customer—was engineered by Downingtown to use a minimum amount of scarce and expensive materials. The double tube sheet construction required special assembly techniques. Notice the large nozzles, which were installed with a minimum of distortion by using proper care and skill during welding. Made of ¼″ solid nickel. Dimensions: 34″ diameter x 17′ 0″ long. Has 292 nickel U-tubes, 1″ O.D. x 16 B.W.G.

We furnish complete thermal and mechanical designs, or fabricate to your plans. Send now for additional information.

Downingtown Iron Works, Inc.

Downingtown, Pennsylvania

New York Office: 52 Vanderbilt Avenue, New York 17, N. Y.

DOWNINGTOWN IRON WORKS

Hackney

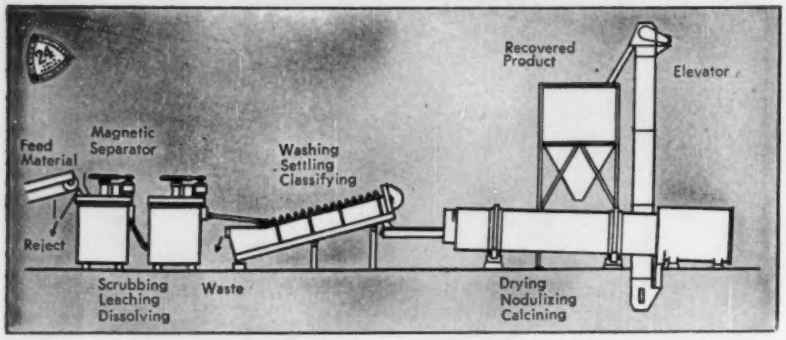
HEAT EXCHANGERS • TOWERS • PRESSURE VESSELS • STORAGE TANKS • STEEL AND ALLOY PLATE FABRICATION

Division of: Pressed Steel Tank Company, Milwaukee 14, Wisconsin • Manufacturer of Hackney Products

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

Denver Reclamation Systems

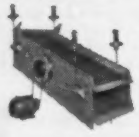
take dollars out of your wastes



If you have valuable materials in your wastes, Denver Reclamation Systems can make recovery profitable. Also, present reclamation systems can be economically modernized.

- **Complete testing, engineering and design services.**
- **Wet or dry systems.**
- **Complete fabrication facilities.**
- **Catalogs and Brochures on Request!**

DECO can supply engineering, laboratory testing, process development and equipment for crushing, grinding, concentration, separation and recovery, settling, filtering, drying and related processes. Also, complete line of laboratory and process equipment such as:

		SIZES	
DENVER Steel-Head **BALL MILL**		**3'x 2' to 6'x 12'**	A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also available. Please write for Bulletin No. B2-B13.
DENVER Spiral Rake **THICKENER**		**3'x 3' to 80'x 12'**	Enclosed, running-in-oil head motion. Patented spiral rakes move settled solids to center discharge with continuous motion, rapid removal of solids tends to eliminate overload. Wood, Steel or Rubber-lined Tanks available. Write for Bulletin No. T5-B5.
DENVER Batch and Continuous **TESTING**		**Laboratory and Pilot**	Use Denver Testing Laboratory facilities for complete batch or pilot tests—your engineers or ours. Ample test facilities for investigations on crushing, grinding, mixing, classification, separation, sampling, leaching, concentration, thickening, filtration and drying. Consultation is without obligation. Please write for Bulletin No. T4-B15.
DENVER Rubber Lined **PUMPS**		**Up to 2400 G.P.M.**	Denver (Soft Rubber Lined) Sand Pumps lower pumping costs 30% to 70% due to simple design, lighter weight and accuracy of rubber parts which increase efficiency 1½ to 3 times over other sand pumps. Have molded rubber impellers and casing liners for long life. Write for Bulletin No. P9-B8.
DENVER-DILLON Vibrating **SCREENS**		**1'x 3' to 6'x 14'**	Gives fast, clean separation without blinding. Gives even, smooth flow of material because of the patented "true-circle" eccentric action. Two-bearing construction saves 50% HP. Please write for Bulletin No. S3-B11.

"The firm that makes its friends happier, healthier and wealthier"

DECO — 24 HOUR SERVICE COMPANY

DENVER EQUIPMENT COMPANY

1400 17th Street • Phone CHerry 4-4466 • Denver 17, Colo.

Denver • New York • Chicago • El Paso • Salt Lake City • Toronto • Vancouver • Mexico, D.F.
London • Johannesburg

PRODUCT INDEX . . .

Turbochargers 85j
Vacuum equipment, high.....L450
Valve operators 440C
Valve service, mobile.....288E
Valves 50-1b, 434a
  Bulletin 2 275
  Blow-off, catalog B-426.....41
  Bronze, globe, form 1001.....285
  Butterfly 339
  Clamp gate 325
  Diaphragm 8, 453
  Gate 445
    Data AD-2080 277
    Forged steel, catalog 10.....58
  Instrument 442B
  Lubricant sealed 69-70
  Lubricated plug 45
  Monel & nickel, bulletin 9.....93
  Plug, catalog 7-CM.....159
  Porcelain 307
  Pump 347
  Rubber & plastic.....231d
  Safety 443A
  Safety relief, catalog 48Ra, Manual 51B 50-1a
  Sanitary & industrial.....443B
  Single flow, bulletin 600.....458
Valves & fittings 78a, 161
Vessels
  Glassed steel, corrosion-resistant 464a
  Pressure 52, 60-1b, BL449
Viscosity control 440D
Water conditioning equipment .....451 G, 451H
Weighing systems 435
Welding systems, arc.....288D
Weldments 434b
Wire cloth 448
  Bulletins 5, 6 & 7.....BL353a
  Catalog E 427
Wire mesh BL351
Wire screens, bulletins 5, 6 & 7.....BL353b

Services

Accident prevention signs.....451A
Arched wafer process L397
Area resources 451B
Barge delivery, chemical.....369
Chemical cleaning, industrial....316
Design & construction.....137, 366
  Chemical plants 127
    Brochure 101 158
  Fertilizer plant 55
  Tank & steel plate structures..129
Engineering & construction.....117
  Prefabricated TL349
Engineering & research.....60-1d
Engineering services, brochure GED2244 .....37-40a
Laboratory testing, batch & continuous 420d
Plant sites 451C
Precision technology, co-ordinated 162-3
Protection, structural steel.....451D
Safety practices 451E
Water service 451I

Flashback

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and service featured last month in New Equipment and in Chemicals and Raw Materials. Use the postcard (p. 459) for more information on any items.

Chemicals

Acid salts, perlauric 148C
Alcohol, isooctyl 146A
Antiozidant 148H
Brominating agents, organic....148G
Flocculation aids 142A
Glycerine carbonate 144B
Graphite, high purity 148B
Herbicide, nonselective, Baron..148I
Latices, acrysol thickened.....148D
Nylon, polyamide 144C
Ozones 138A
Papers, synthetic fiber 148A
Sodium hydride, oil dispersed..144A
Vinyl films 148F

Equipment

Analyzers 310A
Bags, multiwall, snap-open.....322C
Cables, Mylar 148E
Calibrator, flowmeter 310B
Coatings, protective 318A
Controls, level 308B
Covers
  Insulation 318D
  Valve 318C
Detectors, magnetic flow.....318B
Dryers, gas 306A
Electrical assemblies, prefabricated 320B
Filling machines, automatic....322B
Gages, thickness 310C
Generators, steam-hot-water....308A
Insulation
  Motor, rubber 142B
  Silicone-rubber 320D
Joints, expansion 312E
Ozonators 314A
Pumps
  Centrifugal, sealless 312C
  Process 312B
  Teflon-ceramic seal 312D
Purifiers, gas 316A
Seals
  Mechanical shaft 320C
  Rotary shaft 320A
Separators, pneumatic 316B
Tanks, transfer 322A
Valves 312A
Warehouses, mobile.....322D

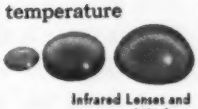
THE *true* STORY of INFRA-RED RIDING HOOD





This is the real low-down. Contrary to the stories about the fateful day I hiked to Grandma's place—the wolf didn't pull the wool over my eyes! Before he knew what was happening, I had him spotted with my SERVOTHERM* system.

Man, is that a batch of instruments! They measure temperature where no contact is possible. My SERVOTHERM system measured the wolf's temperature and differentiated it from the ambient. Those SERVOFRAX glass lenses are real fast—the only glass that will pass the long wave lengths.



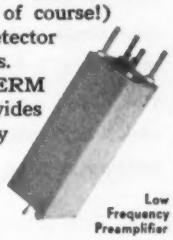
Infrared Lenses and Windows



Thermistor Heat Cells Type 1312

Behind my SERVOFRAX window, I had a SERVOTHERM cell (type 1312, of course!) because it's a fast, sensitive infra-red detector with a time constant less than .005 seconds.

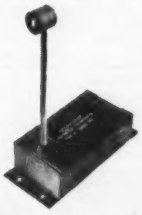
For a preamp, I used the finest—SERVOTHERM Model 1322 low frequency pre-amplifier that provides high gain and high impedance output. This baby is small enough to put in your vest pocket and is terrific for initial amplification for sub-audio and audio frequency signals from extremely low input levels.



Low Frequency Preamplifier

So . . . take a tip from a gal who knows—get on the ball with SERVOTHERM systems and keep the wolf away from *your* door!

*t.m.



Detector Preamplifier Model 1321



Thermistor Power Unit Model 1330

SERVO CORPORATION of AMERICA

New Hyde Park
Long Island, N. Y.

SERVO CORPORATION OF AMERICA
New Hyde Park, Long Island, N. Y.

Please send further information and details on the following:

☐ Low Freq. Preamp. #1322 ☐ Detector Preamp. #1321
☐ Thermistor Power Unit #1330 ☐ Infrared Lenses & Windows
☐ Thermistor Heat Cells, Types 1312, 1317, 1340

Name.....
Position.....
Company Name.....
Company Address.....
City.....Zone.....State.....

CM 7

What It Contains . . .

This is a comprehensive listing of the latest literature you can now get from manufacturers on chemicals, equipment and services in all fields of interest to chemical engineers. It lists new publications just released, in addition to technical literature mentioned in the advertisements in this issue. The latter are identified by an asterisk (*) alongside the company name.

For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

Contents of This Issue . . .

Chemicals and materials 422
Construction materials.. 429
Electrical equipment ... 430
Handling and packaging 434
Heating and cooling.... 435
Instruments and controls 437
Mechanical equipment.. 430
Pipe, fittings, valves.... 440
Process equipment 443
Pumps, blowers, compressors 448
Services and Processes.. 451

Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours—free—for the asking.

Chemicals

Acetic Acid Salts of Fatty Amines..... Armacs are cationic materials unique in their ability to be adsorbed onto metallic & non-metallic surfaces from liquid systems. Booklet covers characteristics & applications.
422A Armour & Co.

Acetic Anhydride.....Eastman acetic anhydride—acetylating agent . . . dehydrating agent in nitration and sulfonation reactions, etc. Makes available complete technical information plus product samples.
422B Eastman Chem. Products.

Acetoacetarylamides.....Valuable bulletin describes the various arylamides including acetoacetanilide, acetoacet-o-toluidide, acetoacet-o-chloranilide, and acetoacet-o-anisidide. Request Technical Bulletin No. F-8259.
422C Carbide & Carbon Chem.

Acetone.....When you make Shell Chemical your headquarters for acetone & other solvents, you automatically have fewer supply worries. Strategically located bulk depots assure prompt deliveries. Catalog No. SC: 54-40.
119 *Shell Chem. Corp.

Acetylene.....At Calvert City, Ky. and at Louisville, Ky., National Carbide can supply you with pipeline delivery of high purity carbide acetylene. Request copy of "The Chemical Century Comes to Calvert City."
422D National Carbide Co.

Acid, Butyric, N-Coco B Amino.....An amphoteric amine derivative, the salts of which make excellent detergent additives as foam boosters and stabilizers. Request Market Development Technical Bulletin.
422E Armour Chem. Div.

Acid, n-Butyric.....Eastman butyric acid . . . for the preparation of butyric esters useful in formulating perfumes and flavorings. Makes available upon request complete technical information plus product samples.
422F Eastman Chem. Products.

Acid, Cresylic.....18 p. Technical Bulletin offers valuable data covering physical properties, chemical properties, Oronite cresylic acids (grades, characteristics & tests, general properties), applications, etc.
422G Oronite Chem. Co.

Acid, Isosebacic.....A new synthetic organic chemical—now being produced in pilot plant quantities for evaluation by research & development groups throughout the chemical industry. Product samples & Data Sheets.
35-6a *U. S. Industrial Chem. Co.

Acid, Muriatic.....Produced from inorganic materials &, at Niagara Falls, is made directly by burning hydrogen with chlorine. You can be sure of purity, quality & consistency of grade to specifications. Request samples.
422H International Minerals & Chem.

Acid, Oleic.....Announces the release of a 20 p. comprehensive booklet on oleic acid. Covers the various means of evaluating oleic acids with emphasis on end-product performance. Request "Emersol Oleic Acids."
422I Emery Industries.

Acid, Peracetic.....Successful bleaching of type 670 nylon—article reprint contains detailed mill procedures for bleaching nylon type 670 and nylon type 200 with peracetic acid. Request Bulletin No. 60.
422J Buffalo Electro-Chem. Co.

Alcohol, Furfuryl.....Derived from agricultural residues & useful in manufacture of wide variety of products including resinous mortars, cements, binder resins, etc. Data on properties & uses in Bulletin No. 205.
422K Quaker Oats Co.

Alcohols.....Dytol alcohols available in quantity . . . are of high, uniform quality, & undergo reactions typical of alcohols: ethoxylation, sulfation, esterification, halogenation, dehydration, etc. Full information.
422L Rohm & Haas Co.

Alcohols, Fatty.....Technical Bulletin covers saturated & unsaturated fatty alcohols. Includes: typical analysis; typical composition; physical properties; typical solvents; suggested industrial application; etc.
422M Archer-Daniels-Midland Co.

Aliphatic Nitrogen Compounds.....Illustrated, 48 p. fully describes line of aliphatic nitrogen compounds for emulsifying — neutralizing — synthesizing — dissolving — saponifying. Request reference, No. F-4770C.
422N Carbide & Carbon Chem.

Alkyl Benzyl Triethyl Ammonium Chloride.....New, 16 p. reference describes Emcol E-11. Includes uses, chemical and physical properties, general information, bacteriology and references. Technical Bulletin No. 45.
422O Emusol Chem. Corp.

Alumina.....Alcoa aluminas are remarkably versatile wherever they are used . . . with hundreds of applications in catalysis, desiccation, refractories and ceramics. Announces availability on request of product samples.
147 *Aluminum Co. of America.

Alumina, Calcined, Metallurgical Grade.....High purity and consistent composition. Eighty per cent of alumina is in crystalline form of alpha alumina. Request detailed information and product samples.
422P Reynolds Metals Co.

Amines, Tertiary.....N-coco morpholine & N-tallow morpholine — tertiary amines, useful in general emulsification problems, corrosion inhibition & the sanitation fields. Request Market Development Technical Bulletin.
422Q Armour Chem. Div.

p-Aminophenol.....Du Pont p-Aminophenol is used to prepare pharmaceuticals, dyes, photographic chemicals, oil additives, and anti-oxidants. Request complete information concerning this valuable intermediate.
422R E. I. du Pont de Nemours.

Ammonium Molybdate.....Company announces the availability upon request of informative literature, "Preparation of Ammonium Molybdate Solutions (1955)" . . . a suggested commercial process. Bulletin No. Ch-5.
422S Climax Molybdenum Co.

Antioxidants.....Antioxidant 425 offers greater protection against discoloration of rubber stocks. Technical Bulletin No. 840 contains complete and up-to-date information on the properties and behavior. 28 p.
422T American Cyanamid Co.

Antioxidants.....dbpc antioxidant is a light-colored solid alkylated phenol—proven highly effective in a variety of industries. Small concentration required for efficient protection makes dbpc economical. Complete data.
423A Koppers Co.

Biphenyl, Chlorinated..... Reports received from installations show that Monsanto Arocior 1248 . . . a chlorinated biphenyl . . . is proving to be a superior heat-transfer medium. Technical Bulletin No. OP-115.
423B Monsanto Chem. Co.

Bleaching, Pulp....."Becco Laboratory Procedures for Pulp Bleaching" provides a number of test procedures for preliminary evaluation of various peroxide pulp bleaching treatments. Request Bulletin No. 66.
423C Food Machy. & Chem. Corp.

Butyl Oleate.....Witco butyl oleate is a stable, non-volatile, oily liquid, which will not solidify under normal winter conditions. Description & information on properties contained in Technical Service Bulletin E-8.
423D Witco Chem. Co.

2-Butyne-1,4-Diol.....Reacts as a glycol & di-substituted acetylene. Chemical intermediate for solvents, plasticizers, plastics, etc. Announces availability of technical information, price schedules and samples.
423E General Aniline & Film Corp.

Calcium Hydride.....Supplies important data on physical properties, chemical properties and applications, handling and storage, available forms and references on company line of calcium hydride. Bulletin 201-D.
423F Metal Hydrides.

Carbon, Activated.....New reference details the uses, advantages & requirements of activated carbon as a catalyst or catalyst support in a wide variety of chemical processes. Request Technical Bulletin 20.
423G Barnebey-Cheney Co.

Carbon, Activated.....Pittsburgh Type BPL granular activated carbon designed to solve vapor phase adsorption problems more efficiently & at lower cost than any other similar material. Product samples & data.
423H Pittsburgh Coke & Chem. Co.

Carbon, Activated....."Solvent Recovery" contains 32 p. & 26 illustrations describing "Columbia" activated carbon solvent recovery system & tells how & where it can be used profitably. Request Booklet No. F-4410.
423I Carbide & Carbon Chem.

Carbon Dioxide.....There's practically no end to the important jobs that CO_2 combined with Liquid Carbonic savvy—is doing. For examples of CO_2's amazingly diversified talents request "Applications Unlimited."
R449 *Liquid Carbonic Corp.

Catalysts.....You benefit with Girdler catalysts: custom design matches your needs; technical service helps you save; quality control assures uniformity; etc. For complete information, request Bulletin G-260.
343 *Girdler Co.

Chemicals.....Folder lists more than 45 new chemicals—Victamide for flameproofing special papers; benzene phosphinic acid for stabilizing alkyd enamels; benzene phosphonic acid catalyst for resins; etc.
423J Victor Chem. Wks.

Chemicals.....Issues new bulletin listing a selected group of synthetic organic & pharmaceutical chemicals. Structural formulas, descriptions & properties of 51 chemicals & pharmaceutical intermediates graphically shown.
423K National Aniline Div.

Chemicals.....Liberally illustrated, 28 p. reference graphically depicts in word and picture Diamond Alkali's family of chemical products for industry and agriculture. Request "The Story of the Chemicals You Live By."
423L Diamond Alkali Co.

* See explanation on p. 422



BECAUSE IT'S NO BONE . . .

IT'S TRAMP IRON! And the operators of a large Midwest plant were sadly surprised when they found this hard, hard "iron bone" in their damaged crushing equipment.

A Dings Magnet would have stopped it. There's one that can stop tramp iron that's causing trouble in *your* plant.

Why not talk to the Dings people—take advantage of over 50 years of leadership in the field of magnetic separation—you'll find the cost of magnetic protection mighty low compared to that of tramp iron damage.

Dings

DINGS MAGNETIC SEPARATOR COMPANY
4730 WEST ELECTRIC AVENUE
MILWAUKEE 46, WISCONSIN

MAIL THIS COUPON TODAY

DINGS MAGNETIC SEPARATOR COMPANY T11553/3
4730 West Electric Avenue, Milwaukee 46, Wisconsin
Please send me further information about Dings Magnetic Separators for protection against tramp iron.

Your Name_____ Title_____
Company Name_____
Address_____
City_____ Zone_____ State_____

Chemicals, Chromium.....68 p. reference covers the history—properties—uses of industrially important chromium chemicals. Includes sodium bichromate, sodium chromate, potassium bichromate, etc. Serial 52.
424A Mutual Chem. Co. of America.

Chemicals, Fatty.....44 p. catalog, "Hydrofol Products," describes all standard ADM fatty chemicals: hydrogenated glycerides, hydrogenated fatty acids, saturated & unsaturated fatty alcohols, sperm oils, etc.
424B Archer-Daniels-Midland Co.

Chemicals, Industrial.....Company makes available their latest reference covering industrial chemicals line. The handy alphabetical listing will help you to find quickly the chemicals you require. Illustrated, 24 p.
101 *Harshaw Chem. Co.

Chemicals, Peroxygen . . . . . Bleaching with some peroxygen chemicals—reprint of a paper on bleaching rayons, cotton, and wool with hydrogen peroxide, peracetic acid & ammonium persulfate. Request Bulletin No. 52.
424C Buffalo Electro-Chem. Co.

Chemicals for Resin Emulsions.....Includes data on: monomers; emulsion polymerization; emulsifiers; protective colloids; proportion of emulsifiers & protective colloids; physical modifiers; etc. Booklet No. F-8869.
424D Carbide & Carbon Chem.

Chemicals, Synthetic Organic.....157 p. compilation of applications & properties for Carbide's complete line of chemicals. Includes alcohols, esters, ketones, glycol-ethers, glycols, etc Book No. F-4372D.
424E Carbide & Carbon Chem.

Chloromethanes.....Valuable data on diverse uses & physical & chemical properties of chloromethanes—methylene chloride, methyl chloride, chloroform, carbon tetrachloride—in new, comprehensive 28 p. reference.
145a *Solvay Process Div.

Defoamers.....For more efficient foam control. Versatile defoamers save space now wasted on foam, cut the processing time, eliminate waste & fire hazard of overflowing foam, etc. Offers complete data & samples.
R447 *Dow Corning Corp.

Detergents.....Whether your cleaning problem is windows, walls, floors, dishes, autos, etc. . . . you'll get better results with Sulframin HD Beads—Ultra's all-purpose detergent. Technical Data Sheet, sample & prices.
424F Ultra Chem. Wks.

Detergents.....World's largest producer of synthetic detergent raw materials provides complete data on line: product description; specifications and tests; properties; uses and applications; etc. Illustrated, 28 p.
424G Oronite Chem. Co.

2,6-Di-tert-Butylphenol . . . . . This material is now ready for testing in your products—as an antioxidant for petroleum products, plastics, rubber & both animal & vegetable fats & oils. Request Fact Sheet & product sample.
424H Ethyl Corp.

Dibutyl Phthalate . . . . . Witco dibutyl phthalate is a stable, colorless, and odorless ester . . . of outstanding value as a plasticizer for nitrocellulose lacquers. For details, request Technical Service Report E-4.
424I Witco Chem. Co.

Dicalcium Phosphate.....Quality and uniformity assured by chemical control from mines to finished products . . . service assured by large-scale production. Company offers Data Sheet with complete information.
424J American Agricultural Chem.

Diethylene Glycol Monobutyl Ether..... Valuable data on butyl Carbitol—physical properties, specifications, shipping data, general solvent properties, constant-boiling mixtures, etc. Bulletin No. F-8636.
424K Carbide & Carbon Chem.

Diethylene Glycol Monoethyl Ether Acetate.....Booklet describes Carbitol acetate—discusses the uses of this glycol-ether, as well as its physical & chemical properties, specifications, etc. Bulletin No. F-4811A.
424L Carbide & Carbon Chem.

Dimethyl Itaconate & Dibutyl Itaconate .....These diesters copolymerize readily with many other monomers, including acrylonitrile, the methacrylates, vinyl chloride, vinylidene chloride, etc. Samples & technical data.
424M Chas. Pfizer & Co.

Diisocyanates.....Product data given on Todi & Dadi, two new isocyanates now available in semi-commercial quantities. Includes general properties, special properties, stability, uses, toxicity, a bibliography, etc.
424N Carwin Co.

Dimethylamino Propylamine & Diethylamino Propylamine.....Clear, colorless mobile liquids—completely soluble in water, benzene, heptane & many other organic compounds. Complete data in reference No. F-8527.
424O Carbide & Carbon Chem.

Dioctyl Phthalate . . . . . Witco dioctyl phthalate is a colorless high boiling ester of outstanding value as a primary plasticizer for vinyl resins. Descriptions, physical properties, etc., in Technical Service Bulletin E-6.
424P Witco Chem. Co.

Dispersion Agents . . . . . The versatile Lomar series of dispersion agents are continuing to improve manufacturing processes and finished products in many diverse fields. Makes available test sample and complete Data Sheet.
424Q Jacques Wolf & Co.

Esters.....Makes available a 40 p. reference describing company's line of esters for lacquer solvents—photographic films—plastics—synthetic dyes — pharmaceuticals — perfumes — etc. Request Book No. F-4766.
424R Carbide & Carbon Chem.

Esters of p-Hydroxybenzoic Acid..... Colorless & practically odorless neutral esters (Parasepts) combine properties of effectiveness, stability & safety—& have long served in wide variety of products. Data & samples.
143 *Heyden Chem. Corp.

Ethyl Bromide.....Michigan Chemical's ethyl bromide often is an economical intermediate to employ for the introduction of the ethyl radical. For complete production information, request descriptive Catalog.
424S Michigan Chem. Corp.

Ethyl Vanillin.....Ethavan (ethyl vanillin) & Vanillin can pep up flavor of inexpensive hard butter coatings & smooth out rich, full body of cocoa butter coatings. Ethavan-Vanillin Taste Test Kit upon request.
424T Monsanto Chem. Co.

Ethylene Cyanohydrin.....Feature high quality—quantity needed (when needed)—technical assistance to help evaluate ethylene cyanohydrin for product or process. Data on properties, reactions, shipping, handling, etc.
424U Carbide & Carbon Chem.

Ethylene Diamine.....Commercial quantities of high concentration ethylene diamine are available from Morgantown, W. Va. plant. Shipments made in tank cars, tank trucks, returnable tin-lined drums. Data & samples.
424V Olin Mathieson Chem. Corp.

Ethylene Oxide.....Prepare non-ionic detergents by using high purity Nitrogen Division ethylene oxide. Data & a bibliography of pertinent literature in "The Manufacture of Non-Ionic Detergents from Ethylene Oxide."
424W Nitrogen Div., AC&D.

Fillers.....Witcarb fillers for polyester resins—reduce overall cost of reinforced plastic parts by extending resin 40-50% without detracting from final cured properties. Request Technical Service Bulletin W-1.
424X Witco Chem. Co.

Glycerine.....Offers valuable booklets including: "Glycerine Alkyds Tailored to Need" (20 p.); reference on glycerine standards & specifications (12 p.); booklet covering properties & applications (16 p.).
379 *Glycerine Producers' Assoc.

Glycols.....Illustrated, 60 p. describes uses & suggested applications for glycols. Tabular data includes properties, shipping information, specifications, test methods & constant-boiling mixtures. Book F-4763.
424Y Carbide & Carbon Chem.

Herbicides.....Describes how Crag Herbicide-1 prevents crabgrass from ever becoming a problem by killing the seeds as they start to sprout. Request Booklet No. F-8651. Slide film in sound and color also available.
424Z Carbide & Carbon Chem.

Hydrogen Peroxide Solutions.....The analysis of hydrogen peroxide solutions—a critical summary of the most useful methods for analysis of hydrogen peroxide solutions at all concentrations. Request Bulletin No. 59.
424AA Buffalo Electro-Chem. Co.

Intermediates.....Company furnishes detailed information on monomethylamine, dimethylamine, trimethylamine. This versatile trio represents the most economical source of the amine group. Technical Data Sheet.
424BB Commercial Solvents Corp.

Latex, Vinyl Acetate Resin.....Designed as high quality vehicle for interior wall sealers & coatings to provide superior color, toughness & resistance to alkalis & cleaning compounds. Technical Bulletins 1 & 225.
424CC Bakelite Co.

Lignin.....14 p. booklet, "Meadol, A Lignin from Hardwood," outlines the properties and industrial applications of the alkali hardwood lignin Meadol, as well as the chemical modifications of this lignin.
424DD Mead Corp.

Lignosulfonates.....Polyfons are lignosulfonates with these properties: solubility in water, alkalies & acids; low surface tension in water; controlled extent of sulfonation; etc. Offers samples & Brochure.
424EE West Virginia Pulp & Paper

Lithium.....Lithium Corp. has developed a series of lithium compounds which have proven to be extremely valuable in the enamel field. Makes available descriptive data sheet, "Use of Lithium in Porcelain Enamels."
424FF Lithium Corp. of America.

Lithium Aluminum Hydride.....8 p. covers valuable data: molecular weight; color & form; stability; solubility; chemical reactions—inorganic; chemical reactions—organic; handling & use; etc. Bulletin No. 401.
424GG Metal Hydrides.

Lubricants.....Ucon fluids & lubricants are entirely different—both in performance & chemical nature—from animal, vegetable & mineral oils, & other brands of synthetic lubricants. Details in reference, F-8326A.
424HH Carbide & Carbon Chem.

Lubricants.....Witco Stayrites #10 and #P-10 are normal soaps and have found extensive application as general-purpose lubricants and medium-efficiency heat stabilizers for vinyl resins. Technical Service Bulletin S-5.
424II Witco Chem. Co.

Methylcellulose.....Heat gel with Methocel (Dow methylcellulose) keeps adhesives in place. Superior synthetic gum gels when heated to keep adhesives from penetrating laminate materials. Data and product sample.
424JJ Dow Chemical Co.

Molybdenum.....'Thermodynamic Properties of Molybdenum Compounds" offers a collection of thermodynamic data for molybdenum & its oxides, sulfides, carbides, nitrides, silicides & halides. Bulletin No. Cdb-2.
424KK Climax Molybdenum Co.

* See explanation on p. 422

Nitroparaffins.....As solvents, the NP's present an unusual combination of properties. Request 8 p. Technical Data Sheet for full details, specifications, properties, uses, solubility tables, chemical reactions, handling.
425A Commercial Solvents Corp.

Oils, Hydrocarbon.....Non-polar hydrocarbon oils provide exceptional service in wide variety of applications—including anti-caking, anti-dusting & detackifying agents, reaction media, etc. Detailed specifications.
425B Pennsylvania Refining Co.

Oils, Sperm.....18 p. folder, "ADM Sperm Oil Products," includes: characteristics; chemical & physical properties, composition; solubility chart; applications & suggested uses; etc. Technical Bulletin No. 904-A.
425C Archer-Daniels-Midland Co.

Phenol.....Employs the newest process and the most modern equipment in the production of phenol, U.S.P. Major manufacturing facilities indicate Oronite as a reliable phenol source. Request fully illustrated Folder.
425D Oronite Chem. Co.

Phthalic Anhydride.....12 p. Technical Bulletin provides detailed information on Oronite phthalic anhydride. Covers chemical & physical properties, important uses, reactions with phosphorus pentachloride, phenol, etc.
425E Oronite Chem. Co.

Plasticizers.....Atlas G-2401 offered to manufacturers & users of glue compositions for evaluation as a plasticizer in printers' rollers, cork binders, dextrin adhesives, gaskets, etc. Technical Bulletin offered on request.
425F Atlas Powder Co.

Plasticizers.....Celluflex CEF builds exceptional fire-retardancy into a wide variety of plastics & surface coatings . . . including polyesters, vinyls, cellulosics, polyurethanes. Test sample & technical data.
168 *Celanese Corp. of America.

Plasticizers.....Citroflex plasticizers are unique in that they are all derived from citric acid, a tribasic, monohydroxy acid well known for its many food applications. Details of line in Technical Bulletin No. 31.
425G Chas. Pfizer & Co.

Plasticizers.....You'll find Adipol ODY an excellent primary plasticizer for most resins. It imparts permanent flexibility & a low temperature flexibility of −70°C. to finished products. Technical data & samples.
425H Ohio-Apex Div.

Plasticizers.....Technical Bulletin describes company's line of Good-rite plasticizers. Includes data on Good-rite GP-265 (octyl decyl phthalate), GP-266 (didecyl phthalate), GP-235 (octyl decyl adipate), etc.
425I B. F. Goodrich Chem. Co.

Polyvinyl Acetate Beads.....For beads that are free-flowing in all viscosities, specify Vinac polyvinyl acetate beads. Beads are perfect spheres even in lower viscosities & minute sizes—do not lump together. Request sample.
425J Colton Chem. Co.

Polyvinyl Acetate Emulsions.....New Polyco 577G for outstanding water resistance—a 55% solids anionic type polyvinyl acetate emulsion designed for interior flat paints—& for coatings for textiles & paper. Data & samples.
425K Borden Co.

Polyvinyl Materials.....Products made from Geon rigid vinyl include corrosion-proof pipe, fume ducts, tanks, trays, materials that can be machined, planed, sawed, drilled, and cemented. Offers technical information.
9 *B. F. Goodrich Chem. Co.

Preservatives.....Fourteen different Dowicide preservatives currently increase manufacturing efficiency or improve product quality for paint, textile, petroleum, adhesives, etc. industries. Full data on uses.
425L Dow Chem. Co.

* See explanation on p. 422



● MORRIS TYPE R SLURRY PUMP at the left is on continuous 24-hr. duty delivering 1000 GPM of a 170° lime slurry at 100′ head. Fifty-HP motor operates at 1180 RPM. Intermittent-duty pump at right delivers 200 GPM at 50′ head with 7½-HP motor turning at 880 RPM.

In slurry-handling operations, "long-term service" is a meaningless claim unless the pump will work day-in and day-out with a minimum of maintenance time, trouble and expense

Morris Type R Slurry Pumps—with an established reputation for longer life—also incorporate in their design exclusive features which result in easier installation . . . fewer interruptions to service...less overhaul...fewer replacements.

To provide uninterrupted service . . .

The gland is under suction pressure only. This reduces leakage and dilution . . . keeps harsh abrasives out of the stuffing box . . . practically eliminates packing troubles.

There are no internal studs or bolts. Caustic and corrosive solutions cannot seep past threads and cause maintenance headaches.

To make installation and dismantling easy . . .

Shell is interchangeable for right or left hand rotation. Suction and discharge nozzles can be rotated around the axis of the pump to a total of 72 different locations.

Impeller removed without disturbing the piping. You simply loosen 4 *outside* clamping bolts and pull off the end cover. This feature alone saves considerable time and labor.

● *Free Service.* Morris Engineers will be glad to recommend the pump best suited to your needs for size, capacity, etc. Send necessary data today . . . include request for Bulletin 181.

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

MORRIS *Centrifugal Pumps*

Even More Surface

per sq. ft. of face area

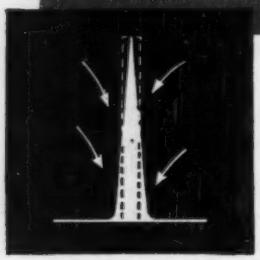
Even Less

Air Friction



with the New AEROFIN Type B

Smooth-Fin Heat Exchangers



Tapered Fin

The new smooth fin is tapered, with a wide contact base which conducts sufficient heat to make the entire fin effective transfer surface. It is no longer necessary to crimp the fin to provide the required contact area.

By eliminating the air resistance and turbulence caused by the fin corrugations in the old-type coils, it is now possible to use almost twice as many fins per inch with no increase in air friction.

The resulting increase in capacity is obvious. As a consequence, these new coils offer:

Greater capacity per square foot of face area

Lower airway resistance – less power needed to deliver the required C. F. M.

Smaller face area, due to the practical use of higher air velocities

Fewer rows of tubes for a given B.T.U. transfer in a given area

Less weight – easier handling

Better drainage of condensation from water coils; improved venting and drainage for heating coils

Compact, sturdy design

Standardized encased units arranged for quick, economical installation

Aerofin is sold only by manufacturers of fan-system apparatus. List on request.

AEROFIN CORPORATION SYRACUSE 1, N.Y.

LITERATURE . . .

Propylene Glycol.....New 16 p. Folder presents data on physical and physiological properties, specifications, shipping containers, constant-boiling mixtures, solubilities, and applications. Data Folder F-8738.
426A Carbide & Carbon Chem.

Reagents.....Aerofloc reagents are synthetic polymers which are useful in flocculating finely-divided solids in aqueous suspensions. Help solve filtration or thickening problems—request valuable Brochure.
426B American Cyanamid Co.

Reagents.....Dajac reagents feature only the highest purity & quality. Announces the release of a new & enlarged catalog listing over one hundred reagents required for medical research & biochemical testing.
426C Dajac Labs.

Reodorants.....Releases valuable bulletins: "Theory of Odor & Alamask;" "Alamask for Petroleum Industry;" "Air Pollution Abatement for Petroleum Refining Operations;" "Alamask for Rubber Industry;" etc.
426D Rhodia, Inc.

Resin Dispersions.....Carpet sizing compounds made with Hercules Dresinol reduce backing costs and materially improve wearing qualities in all types of cotton, wool, and mixed fiber carpets. Descriptive Booklet.
426E Hercules Powder Co.

Resins.....Unplasticized rigid PVC made from Exon 402-A wipes out corrosion. It features outstanding resistance to alkalis, acids, inorganic salts, and other corrosive fluids. Makes available complete information.
364 *Firestone Plastics Co.

Resins.....New resins, Lustrex 710 & 770, are suggested as tackifiers, dispersants, thickeners & flocculants in a variety of aqueous systems. A 10 p. bulletin, including 5 viscosity curves, available on request.
426F Monsanto Chem. Co.

Resins.....Use the unique properties of Piccolastic resins . . . to improve your products. Makes available samples and a Bulletin furnishing complete information regarding the various grades of these resins.
426G Pennsylvania Indus. Chem.

Resins, Acylic.....Lucite acrylic resins available with a wide range of molding characteristics & properties & in a variety of transparent, translucent & opaque colors. Offers descriptive literature on request.
133a *E. I. du Pont de Nemours.

Resins, Casting.....Literature describes Epocast 4-C . . . an aluminum colored casting resin primarily designed as a facing for kirksite, lead, cast iron, or aluminum die cores. Request Technical Bulletin EP-54-9a.
426H Furane Plastics.

Resins, High Styrene.....Darex 43G is an excellent rubber reinforcing resin for shoe soles, floor tiles, wire & cable insulation, mechanical molded goods. Characteristics, features, etc., in new Brochure No. C-15.
426I Dewey & Almy Chem.

Resins, Industrial.....For new developments in industrial resins & varnishes, plastics compounds, silicones, electrical insulating materials, plastics laminating & molding, etc. request Booklet No. CDG-101.
426J General Elec. Co.

Resins, Laminating.....Furnishes a descriptive reference describing Epocast 2 . . . an unfilled, fast setting epoxy resin primarily intended for laminating at room temperature. Request Technical Bulletin EP-54-24.
426K Furane Plastics.

Resins, Nylon.....Zytel is the du Pont trade-mark for a versatile group of long-chain synthetic polymeric amides exhibiting extreme toughness & strength. Complete data on properties & applications on request.
133b *E. I. du Pont de Nemours.

* See explanation on p. 422

Resins, Polyethylene.....Illustrated, 16 p. includes: what is polyethylene?; how is it made?; what are its properties?; what is it used for?; how is it processed?; how is it fabricated?; etc. Request booklet, No. 5M555.
427A U. S. Industrial Chem. Co.

Resins, Polyethylene.....Tough, flexible Alathon polyethylene resin stands up well against abrasive slurries. Widely used in industrial pipe applications. Offers complete information on the properties and applications.
133c *E. I. du Pont de Nemours.

Resins, Tetrafluoroethylene.....Teflon tetrafluorotheylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.
133d *E. I. du Pont de Nemours.

Rosin.....Offers 8 p. booklet on Galex, a stabilized non-oxidating rosin which is specifically compounded for all uses where ordinary rosin is detrimental due to oxidation. Covers typical properties and numerous uses.
427B National Rosin Oil Products.

Salt Tablets, Impregnated.....Salt lost through perspiration causes fatigue and heat exhaustion. All this can be eliminated by taking Pep-Up impregnated salt tablets. Detailed literature and price data upon request.
427C U. S. Safety Service Co.

Salts, Tetrazolium.....Blue Tetrazolium is extremely useful in demonstrating oxidation-reduction enzymes in tumors. It is used as a standard for cortisone determination. Makes available descriptive Data Sheet.
427D Dajac Labs

Silica, Colloidal.....A submicroscopic particulate silica prepared in a hot gaseous environment (1100°C.) by the vapor phase hydrolysis of a silicon compound. Properties, functions and uses in Booklet No. CGen-1.
427E Godfrey L. Cabot.

Silica Gel.....A superior drying agent for natural gas. For detailed information and field performance data on the use of Davison silica gel for the drying of natural gas request Technical Bulletin No. 201.
91 *Davison Chem. Co.

Soda Ash.....West End is a pure white, free-flowing and rapidly soluble soda ash that produces a far cleaner, more uniform product. Announces the availability of product samples, prices, and technical information.
12 *West End Chem. Co.

Sodium Chromate Tetrahydrate..... Small yellow crystals which dissolve readily in water to give a very bright solution substantially free from iron, vanadium & trivalent chromium. Request Product Data Sheet MP-1.
427F Mutual Chem. Co. of America.

Sodium Dispersions.....Illustrated, 32 p. book, "Using 'Ethyl' Sodium in Dispersed Form," covers: advantages of dispersions; uses of sodium dispersions; preparation of dispersions; handling dispersions; etc.
427G Ethyl Corp.

Sodium Hydride.....Includes pertinent data: molecular weight; crystalline form & color; density; typical analysis; melting point; heat of formation; heat of reaction with water; etc. 7 p. Bulletin No. 507.
427H Metal Hyrides.

Sodium Molybdate.....Announces the availability of descriptive literature, "Where to Get Sodium Molybdate." Sources of small packages of sodium molybdate for experimental work. Request copy of Bulletin No. Ag-3.
427I Climax Molybdenum Co.

Sodium Sulfonates.....Have gained wide recognition & are being extensively used in industrial operations & processes which include: emulsification; emulsion breaking; dispersion; detergency; etc. 16 p. Bulletin.
427J Oronite Chem. Co.

* See explanation on p. 422



Are you using wire cloth or wire cloth parts which must be corrosion resistant? Are the service conditions in your plant really tough? If you have a problem selecting the proper anti-corrosive alloy, Newark Wire Cloth may have the answer.

Available in all corrosion resistant metals, Newark Wire Cloth is accurately woven in a wide range of meshes, ranging from very coarse to extremely fine.

If you have a wire cloth problem involving corrosion, please tell us about it . . . we may have the answer.

NEWARK for ACCURACY

A complete line of woven wire cloth and wire cloth parts in all malleable metals.

Send for Catalog E

Newark Wire Cloth COMPANY

351 VERONA AVENUE • NEWARK 4, NEW JERSEY

production line...



or shipping room

Nearly 50 years of conveyor experience

Standard cuts conveying costs in *either* or *both* places

To speed operations, reduce breakage, increase safety, save manpower, time and money — mechanize handling with Standard conveyors. *It's an investment in efficiency that will pay you for years.*

Standard can be of expert service to you on any conveyor need. This includes complete engineered systems of conveyors for production, assembly or packing lines . . . or a simple lightweight section of roller conveyor for "spot" use in warehouse or shipping room.

Standard designs and builds all types of "package" conveyors: power and gravity, belt, roller, slat, push-bar and special units as well as a wide line of self-contained portable work-savers.

The range, versatility and flexibility of Standard Conveyor equipment have been developed in nearly 50 years of service to industry. Call Standard's representative listed in your classified phone book. Send for Standard's General Catalog — address Dpt. CE-75



STANDARD CONVEYOR COMPANY
General Offices: North St. Paul 9, Minnesota
Sales and Service in Principal Cities



GRAVITY & POWER Conveyors
ROLLER • SLAT • WHEEL
SECTIONAL • BELT • CHAIN • PUSH-BAR
PORTABLE CONVEYOR UNITS:
HANDIBELT • INCLINEBELT • EXTENDOVEYOR • UTILITY BELT-VEYOR
HANDIPILER • LEVEL BELT • LITEWATE • HANDIDRIVE
PNEUMATIC TUBE SYSTEMS

LITERATURE . . .

Solvents.....You can obtain any type of solvent you require from Carbide . . . ketones, esters, alcohols, and glycol-ethers. Company furnishes their "Solvent Selector for Coating Formulations," No. F-7465C.
428A Carbide & Carbon Chem.

Solvents.....Your guarantee of a consistently good paint—use Espesol solvents of superior uniformity. Catalog describes complete line for synthetic enamels, resins, varnishes, for thinning surface coatings.
428B Eastern States Chem. Corp.

Stabilizers.....“Witco Stayrites, Stabilizers for Vinyl Resins” describes materials & methods for stabilizing vinyl resins. Covers 14 stabilizers of cadmium-barium, synurgist, non-toxic, lead, etc. types. 24 p.
428C Witco Chem. Co.

Starches.....Valuable 56 p. booklet, “The Story of Starches,” completely describes the broad variety of National starches, the way they are produced, and the miracle of “man-made” starch derivatives. Request your copy.
428D National Starch Products.

Stimulants, Oil-Well.....An 8 p. booklet just published gives full technical information on ATPET 931 . . . a chemical used for economical treatment of oil wells that are subject to water damage. Request reference, No. CD-88.
428E Atlas Powder Co.

Styrene Molding Materials.....Releases up-to-date wall chart comparing properties of styrene molding materials. Covers recommended area of application, particle form, lubrication, recommended mold temperature, etc.
428F Monsanto Chem. Co.

Sulphuric Anhydride, Stabilized.....Sulfan has 99.5% SO_3 available for sulfonation reactions. In many applications, this means considerable savings in operating costs. Request complete technical information.
109 *General Chem. Div.

Surface Active Agents.....100%-active nonionic surface-active agents offer over-all balance of desirable properties; ease of formulation, stability, controlled sudsing, etc. Complete technical data on Pluronics.
428G Wyandotte Chem. Corp.

Surfactants, Non-Ionic.....HLB values for over 100 surfactants made by various manufacturers are presented in a booklet entitled, “Calculation of HLB Values of Non-Ionic Surfactants,” available from Atlas on request.
428H Atlas Powder Co.

Tolylene Di-Isocyanate.....Nacconate 80—isomeric mixture of 80% 2,4-tolylene di-isocyanate and 20% 2,6-tolylene di-isocyanate. Product samples, detailed technical information and quotations available upon request.
428I National Aniline Div.

Triethyl o-Formate.....A unique ester, closely resembling an acetal, stable in the presence of alkali, unstable in the presence of acid, and a source for the ethoxy methylene group. Technical Bulletin upon request.
428J Kay-Fries Chem.

2,4,7-Trinitrofluorenone..... Furnishes valuable data on 2,4,7-trinitrofluorenone . . . a new reagent for the identification & separation of polynuclear hydrocarbons & their derivatives. Request Data Sheet.
428K Dajac Labs.

Tris (Hydroxymethyl) Aminomethane..... See what highly reactive nitroparaffin (“Tris Amino”) derivative can do for you—the only tri-hydroxy molecule commercially available having a primary amine group. Data & samples.
428L Commercial Solvents Corp.

N-Vinyl-2-Pyrrolidone.....Will copolymerize with almost all vinyl monomers. Permits modification of many properties in existing homopolymers. Request technical information, price schedules and product samples.
428M General Aniline & Film Corp.

* See explanation on p. 422

Wax Removers.....Makes available reprint entitled, "Wax Removing Floor Cleaners." Includes: properties of a remover; dispersing action; hard water tolerance; use of non-ionics; viscosity; etc. No. F-8827.
429A Carbide & Carbon Chem.

Waxes, Petroleum.....Cardis One is the hardest emulsifiable petroleum wax on the market. It gives the luster and lasting brilliance only wax-rich emulsions can create. Request literature and product samples.
429B Warwick Wax Co.

Construction Materials

Adhesives.....Company makes available a new Technical Data Sheet which describes the physical properties and installation characteristics of "3M" brand ceramic tile adhesive (CTA-12) for installing floor tile.
429C Minnesota Mining & Mfg.

Adhesives.....Profusely illustrated, 16 p. includes sections on: custom compounding; new problems; industrial products; products for defense; shoe adhesives; technical facilities; and service and representatives.
429D Angier Products.

Adhesives, Resin Emulsion.....Company issues a new Folder which lists over dozen Darex resin adhesives. Reference tells what they are, and where and how to use them. Included is a handy "Selection Chart." 4 p.
429E Dewey & Almy Chem. Co.

Alloys, Fabricated.....Illustrated, 28 p. Corrosion Resistant Section presents 102 baskets, crates, racks, tanks, sinks, shell case equipment, & "George" Rolock's tote box truck. Request Catalog No. B-9.
429F Rolock, Inc.

Alloys, Hard-Facing.....Illustrated, 44 p. Manual includes sections on: what metals can be hard-faced; how to select right rod; which welding process to use; properties; applications; etc. Reference No. F-7338C.
429G Haynes Stellite Co.

Aluminum.....Process industry applications of aluminum for producing everything from beer to bomb shells are thoroughly analyzed in illustrated, 80 p. book, "Process Industries Applications of Alcoa Aluminum."
82 *Aluminum Co. of America.

Coating Systems, Protective.....Neoprene coating systems & a special modified vinyl system have joined up with 16 other Ucilon coating systems that stop hundreds of severe corrosives. Details in Bulletin No. MC-9.
382a *United Chromium.

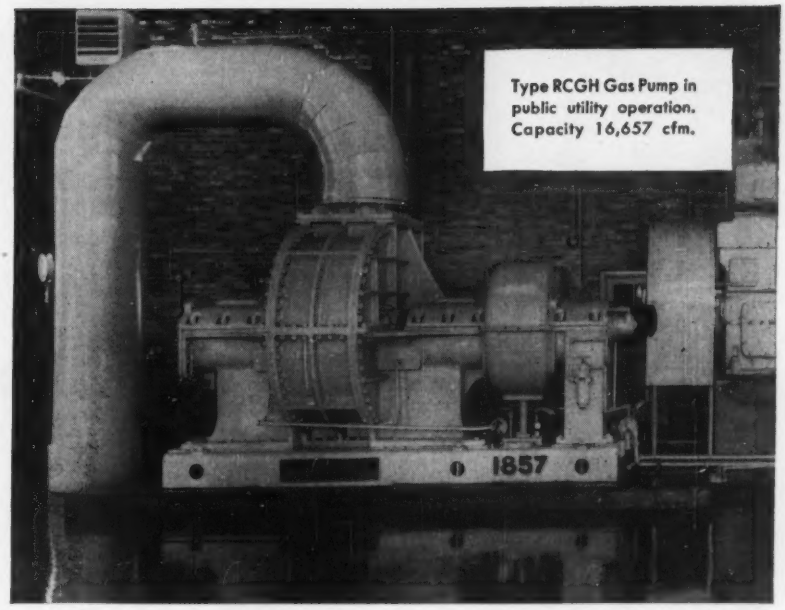
Coatings, Protective.....Prufcoat "A" Hot-Spray Vinyl gives greater mil thickness, improved film density, & better adhesion at lower cost per sq. ft. of surface. Valuable features, properties, etc. in Bulletin 240.
429H Prufcoat Labs.

Coatings, Protective.....Booklet offers essential information on the advantages and technical properties of Alcoplate coatings, together with a review of Alco's experience and facilities in nickel plating. 8 p.
247 *Alco Products.

Coatings, Protective.....Del protective coatings are designed to do specific jobs in the chemical process industries on new construction, maintenance and products finishing. Describes line in 12 p. Bulletin.
429I David E. Long Corp.

Coatings, Protective.....Prufcoat Gloss Vinyl Mastic is perfected vinyl base mastic with exclusive "gloss" finish that substantially improves chemical resistance, gives measureably better appearance. Bulletin 260.
429J Prufcoat Labs.

* See explanation on p. 422



PERFORMANCE OF R-C GAS PUMPS ASSURED BY "BIG 4" ESSENTIALS

CHECK THE "BIG 4" ESSENTIALS

1. *Positive flow*—because of positive displacement principle maintaining the quantity of delivery
2. *Pressure*—controlled to your requirements
3. *Capacity*—always up to ratings, with moderate short time overloads
4. *Economy*—in first cost, power and low maintenance

You may find it profitable to compare your present gas pump performance with R-C proved economy and reliability.

For delivering or exhausting gas in industrial operations, R-C Gas Pumps and Exhausters, in either the Rotary Positive or Centrifugal types, have long demonstrated their complete reliability, efficiency and economy.

For many years, they have been the choice of plant engineers and of leading builders of industrial equipment, where the movement of gas is an essential part of the process.

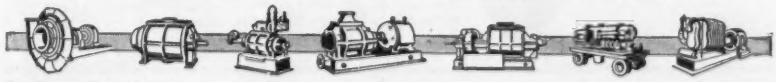
Capacities from 5 cfm to 50,000 cfm at moderate pressures offer close selections for specific needs . . . and further economies are gained from compactness, reducing space requirements and installation costs.

For any present or future project requiring gas pumps or exhausters, ask us for details on R-C equipment, and for help in planning your installations.

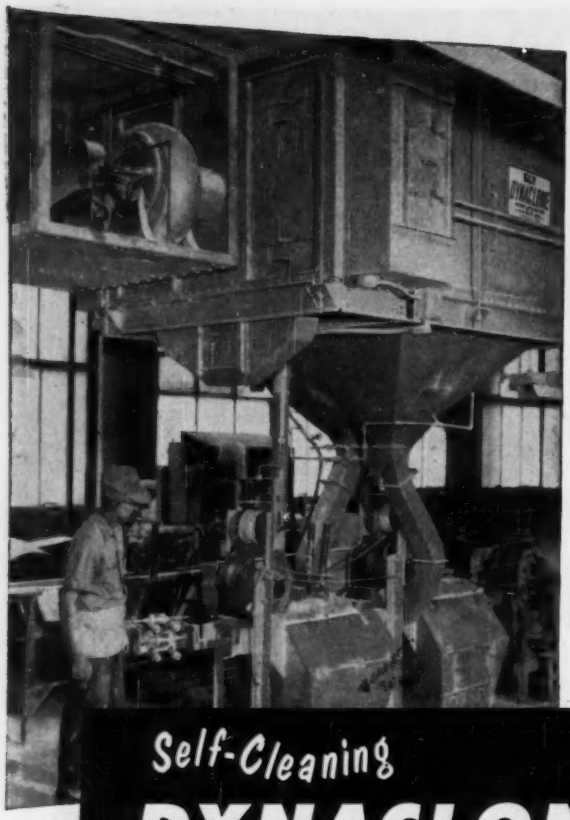
ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
755 Illinois Ave. • Connersville, Indiana

Roots-Connersville Blower (Canada) Ltd. • 629 Adelaide St. W., Toronto, Ont.



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiroxial Compressors



1 OF 4 UNITS AT GOODRICH

Self-Cleaning

DYNACLONE

The Ultimate Dust Collector

No matter how dusty your manufacturing operation, you can effectively control the dust. Take the case of The B. F. Goodrich Company.

This company processes garden hose by passing it through pigment dusting chambers. There are two dusting chambers—shown on the floor below the filter—one for soapstone (talc) and the other for zinc stearate.

Dust-laden air from this operation is drawn through vertical ducts to the Sly Dynaclone two-compartment Filter, above. The dusting compounds are kept separate and are returned to the chambers for re-use and the cleaned air returned to the plant. *No material is wasted—all is used, meaning substantial savings. No cleaning-up operation—always a clean plant!*

Self-cleaning by reverse air, the Sly Dynaclone represents the greatest advance ever made in industrial dust collection. Without added motors or blowers, it maintains a constant, uniform suction at dust sources. No shutdowns, no shaking, no wearing of bags. In use since February, 1951, it has operated continuously—*24 hours a day*. Well pleased, The B. F. Goodrich Company has purchased large Dynaclones for three other plants.

Manufacturers of: Dust Control Systems, Blast Cleaning Equipment, Tumbling Mills, Industrial Ovens.

THE W. W. SLY MANUFACTURING CO. (SINCE 1874)

4771 TRAIN AVENUE • CLEVELAND 1, OHIO

New York • Chicago • Philadelphia • Rochester • Birmingham • Cincinnati
Buffalo • St. Louis • Minneapolis • Detroit • Denver • Los Angeles • Toronto

PIONEERS AND LEADERS IN INDUSTRIAL DUST CONTROL

LITERATURE . . .

Coatings, Protective.....For any equipment or surface that can be uniformly baked. . . . Plastisol compounds offer easy, economical way to apply long-lasting vinyl coating protection. Details in Bulletin No. VP-1.
382b *United Chromium.

Coatings, Protective.....Inertol protection means lower cost per year. "A Panoramic View of Inertol Paints" shows use in sewage treatment works, pools, industrials, water treatment plants, etc. Illustrated.
430A Inertol Co.

Coatings, Protective.....The "Amercoat 33/86 System" has proven amazingly helpful...to control corrosion where only minimum surface preparation is possible. For details, request descriptive literature.
261 *Amercoat Corp.

Coatings, Protective.....Releases a new reference on protective coatings. Included are neoprene heavy duty, neoprene extra heavy duty, styrene, chlorinated rubber & epoxy resin based coatings. Bulletin No. 7-2.
430B Atlas Mineral Products Co.

Coatings, Protective.....Now . . . your own painter can "cold-galvanize" any steel surface with Dimetcote (100% inorganic zinc coating) . . . any place —anywhere—anytime. Request Dimetcote Technical Bulletin.
311 *Amercoat Corp.

Coatings, Protective, Odorless.....Destroy odor problems heretofore created by chemical-resistant painting—provide highest resistance to acids, alkalis & other chemicals. Easy-to-apply & in a variety of colors. Bulletin 250.
430C Prufcoat Labs

Plastics.....The Silent Treatment" covers vermiculite acoustical plastic & its application. Contains a table of physical data, standard specifications for manual & machine application, etc. Numerous photographs.
430D Vermiculite Institute.

Plastics, Laminated & Molded.....Announces the availability upon request of a new 12 p. illustrated bulletin which describes more than thirty-five different types and grades of Insurok laminated and molded plastics.
430E Richardson Co.

Plastics, Reinforced.....Reinforced plastic materials widely used for sports car bodies, boats, modern furniture, etc. Other new uses for reinforced plastics contained in reference, "A Sketchbook of Profitable Products."
430F Monsanto Chem. Co.

Primers.....Prufcoat Fast-Dry Primer P-50 offers advantages of finest universal metal primer on market, & in addition enables a complete coating job, from primer-to-top coat, in one day. Data in Bulletin 016.
430G Prufcoat Labs.

Electrical & Mechanical

Belts, V-.....Switch to Veelos adjustable v-belt—the one v-belt that keeps your drives on the go. Easier to install—in many cases installation is completed in 50% to 90% less time. Request Veelos Data Book.
81 *Manheim Mfg. & Belting Co.

Conduit, Electrical.....New booklet describes heavy-duty, rigid steel electrical conduit, Superduct. Shows how conduit stands up under corrosive attacks of salt spray, sulfuric acid, caustic soda, heat exposure, etc.
430H National Elec. Products Corp.

Connectors.....MI" Series Connectors for simplified installation of safety mineral insulated cable: fewest components—no messy compounds—no maintenance—no wire pulling. Details in Bulletin TMI-455.
152 *Appleton Elec. Co.

* See explanation on p. 422

Does A Six-Week 500% Return On Equipment Cost Stir Your Imagination?

●

(A CASE HISTORY)

In the processor's own words . . . *"More than 750 tons of hydroforming catalyst were processed in the first six months. This included catalyst of widely varying quality . . . Increased value of the recovered catalyst is more than five times the original cost of the equipment. In addition, continued use of the equipment will reduce hydroforming operating costs considerably by reductions in fresh catalyst purchases . . . The specific gravity separators are probably the most important items of equipment in the plant . . . Utilization of the equipment for separation of other types of catalyst used at (name of plant) is under consideration."*

In both particle and bulk form, the ⅜-inch catalyst pellet, described above, is not unlike many other types of dry chemical and industrial materials. And, although this particular application of Sutton equipment is spectacular, it represents only one of more than a hundred different types of chemical and industrial products being successfully separated, salvaged, cleaned, or classified through use of the famous sixty-seven year-old SS&S Process — *"the separation of dry materials by effecting differences in specific gravity through air-flotation."*

Consider your own processing problems carefully. From fourteen basic models, incorporating 64 different types and sizes of Specific Gravity Separators and Air-Float Stoners, Sutton may be able to provide an immediate and profitable solution.

May we send you a reprint of the complete "catalyst story"? Or, better still, drop us a line describing *your* particular separating problem.

●

SUTTON, STEELE & STEELE, INC.
1031 SOUTH HASKELL • DALLAS, TEXAS
Mailing your inquiry on company letterhead directly to Dept. C (at the above address) will greatly facilitate its prompt handling.

Fights CORROSION *HARD*

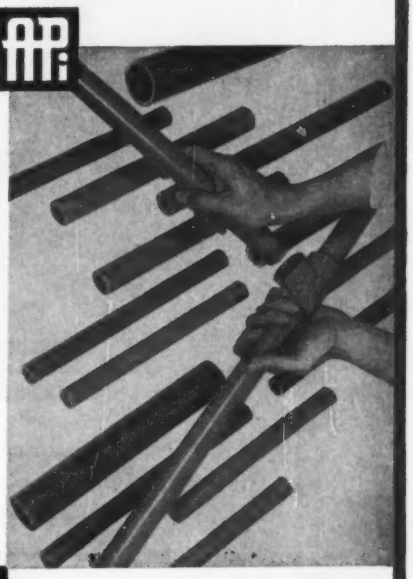
ALPHA 101 AND 103 — Rigid PVC Plastic Pipe

Recommended for 3 out of 4 Chemical Lines

Good at licking corrosive problems. Mighty good for its perfect resistance to hydrochloric . . sulphuric . . nitric acid and more than 186 commonly used chemical corrosives — at lower temperatures and pressures.
When the right PVC Pipe handles your fluid lines you solve corrosion problems permanently! That's why
ALPHA 101 Normal Impact Unplasticized Straight PVC
or
ALPHA 103 High Impact Unplasticized Modified PVC Pipe
is increasingly used! 1/2" to 4" sizes; full line of fittings.

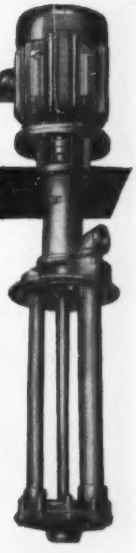
- LIGHT WEIGHT
- EXCELLENT AGING QUALITIES
- NON FLAMMABLE
- HIGH TENSILE STRENGTH

Send for Complete Product Data Today



ALPHA PLASTICS INC.
14-16 NORTHFIELD ROAD
WEST ORANGE, N. J.





. . . HAVE SOMETHING IN COMMON

They are both built to take it . . . for long, gruelling service. Both are engineered to the Nth degree. Boeing selected a Nagle 2" type "SW-OB" vertical shaft, centrifugal pump for pumping a chromium solution into dip tanks. Many parts of Boeing planes are processed with chromium to provide a durable exterior finish. Production schedules rule out leakage, failures, packing troubles. This Nagle Pump was designed to eliminate these troubles. Nagle Pumps are built for abusive service only—handling abrasive, or corrosive materials or hot liquids. Get the facts—send for Catalog 5206.

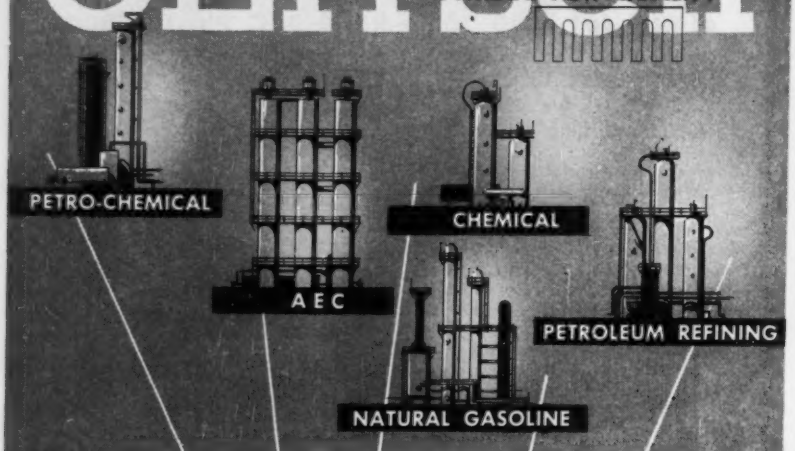
NAGLE PUMPS



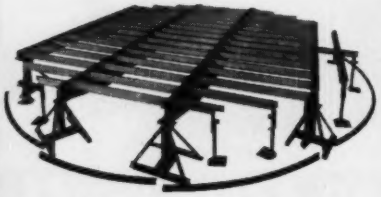
NAGLE PUMPS, INC.
1235 CENTER AVE., CHICAGO HEIGHTS, ILL.
PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

GLITSCH

SYMBOL FOR QUALITY



In all types of processing plants GLITSCH equipment allows greatest design latitude in tray size, process layout, type of flow, type and shape of downcomer, weirs, and size and shape bubble caps as well as suitable corrosion resistant material. Use of GLITSCH "Truss-Type" lightweight trays and bubble caps has produced such outstanding reductions in "off-stream" time that entire investments have been repaid quickly. GLITSCH sales engineers are located in principal chemical processing areas.

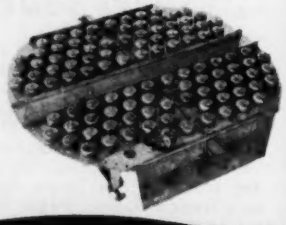


This is the GLITSCH "Truss-Type" mechanical structure which allows complete freedom of design for your process requirements.

Dies are available for hundreds of different bubble cap and riser assemblies.

SAVINGS are effected in design, fabrication, installation and maximum "on-stream" performance.

WRITE or CALL for TECHNICAL BULLETIN





GLITSCH sales offices are located at
New York • Chicago
Cleveland • Houston
Tulsa • Los Angeles

Glitsch
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS

LITERATURE . . .

Drives.....Releases first in series of bimonthly publications devoted to application of power transmission equipment to meet today's industrial needs. "Better Drives" deals with drives for heavy-duty belt conveyors.
432A W. A. Jones Foundry & Mach.

Drives, Shaft Mounted.....These versatile, new speed-reducing units save space, power, material and time. Makes available an engineering Bulletin which includes selection, application and dimension details.
317 *Falk Corp.

Drives, Silent Chain.....88p. brochure offers detailed engineering data. Covers design and application information, drive components and accessories, operational and technical data, etc. Request Book No. 2425.
63 *Link-Belt Co.

Drives, Variable Speed.....Stepless—instant starting—compact—50:1 speed range—good regulation without tachometer—long life—virtually maintenance free service—low cost—etc. Bulletin S580-5-55.
415a ***Magnetic Amplifiers.**

Expanders, Tube.....Makes available illustrated News Bulletin showing the latest tube expanding equipment available for fire tube boilers, water tube boilers, condensers and similar heat transfer units. 4 p.
432B Gustav Wiedeke Co.

Motors.....Announces the availability of a new multi-color 8 p. reference entitled, "Automation Through Varitrol Control," which illustrates the numerous features of Varitrol control and U. S. Varidrive motors.
432C U. S. Elecl. Motors.

Motors.....Find out about Star-Kimble special motor designs. Request company's informative literature covering standard squirrel cage—brake-motors —wound rotor—D-C motors... generators...M-G sets.
R351 *Miehle Printing Press & Mfg.

Motors.....Here is extra motor value—double-shielded bearing . . . large grease reservoirs . . . bolted-on bearing cap . . . labyrinth seals. For complete details on bearing design, request Bulletin 51B7225.
98 *Allis-Chalmers Mfg. Co.

Motors.....Positive protection . . . positive identification—all new Reliance A-c. Motors provide these 2 essentials to trouble-free operation in hazardous or corrosive atmospheres. Bulletin No. B-2401.
34 *Reliance Elec. & Engrg. Co.

Motors.....The only motor with a built-in pinion—U. S. Syncrogear. 16 p. descriptive booklet presents engineering acts you should know about geared motors & illustrates the various U. S. Syncrogear types.
363 *U. S. Elecl. Motors.

Motors.....12 p. reference covers many revolutionary features of all-new U.S. Type H Uniclosed motor. Cut-open views of motor, illustrating its various constructional features, shown in full color. Request Booklet No. 1856.
432D U. S. Elecl. Motors.

Motors, Fan-Cooled.....Totally-enclosed, fan-cooled motors . . . for chemical plant applications. Feature long life, minimized maintenance and top efficiency. Details in Chemical Motor Bulletin No. CE-3379.
253 *Diehl Mfg. Co.

Packings, Mechanical.....Illustrated, 76 p. describes Chesterton mechanical packings, boiler tube scrapers, Rustsolvo and Spraysolvo, Belt-Flo belt dressing, gauge glasses and accessories. Catalog No. 24-B.
432E A. W. Chesterton Co.

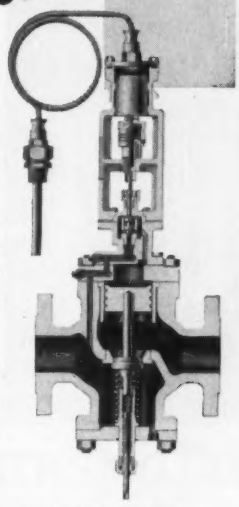
Packings, Saddle Tower.....New 16 p. reference shows how Intalox saddles can help you reduce tower heights, lower gas pumping costs, or obtain greater capacity from your present tower. Request Bulletin S-29.
102 *U. S. Stoneware Co.

* See explanation on p. 422

FOR CONTROLLING TEMPERATURE OF LIQUIDS OR GASES

TEMPERATURE REGULATORS

FOSTER TYPE T



Foster manufactures a complete line of temperature regulators for all types of service — for hot water storage heaters, fuel oil heaters, pasteurizers, ovens, driers, cookers and other process heating and cooling equipment.

They are available in single or double-seated construction; direct or reverse acting; in combination with pressure reducing valves; and in proper materials for the type of service.

Like all Foster valves, they are designed and built for long life with a minimum of maintenance, and are easy to service when necessary. Ask for Bulletin T-101.

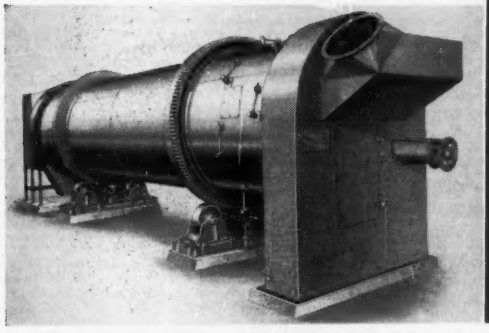
FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE — UNION, N. J.

AUTOMATIC VALVES • CONTROL VALVES • SAFETY VALVES • FLOW TUBES

DAVENPORT ROTARY

HOT AIR DRYER 6'0" dia. x 25'0" long



DAVENPORT

PRESSING – DRYING and COOLING Equipment

Continuous DeWatering Presses

ROTARY DRYERS Steam Tube, Hot Air and Direct Fire

Atmospheric DRUM DRYERS

ROTARY COOLERS Water and Air

Cereal Process Drying

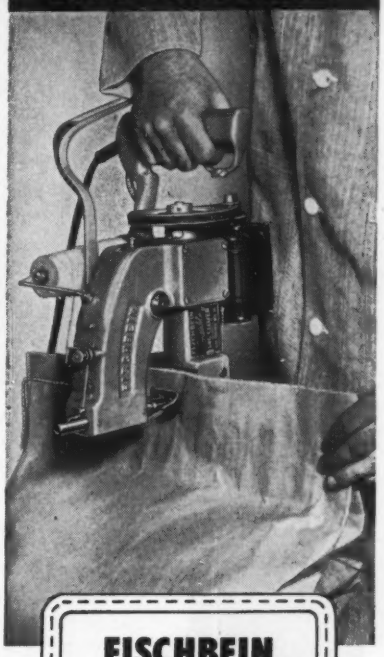
This "Davenport" Rotary Hot Air Dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten.

Let our engineers consult with you on your Pressing, Drying, and Cooling problems. Send for complete Catalog A, or for quick reference, consult your *Chemical Engineering Catalog*, 1954 or 1955.

davenport MACHINE and FOUNDRY COMPANY

DAVENPORT, IOWA U. S. A.

FOR FAST, SECURE, LOW COST BAG CLOSING



FISCHBEIN Portable BAG CLOSER

- A *truly* portable bag closer . . . Weighs only 10½ pounds.
- Requires no installation . . . plug into any outlet.
- Handles textile and paper bags.
- Simple to operate and maintain.
- Lowest priced bag closer on the market.

FOR DETAILS, MAIL THIS COUPON NOW

DAVE FISCHBEIN CO.
DEPT. 3C
38 GLENWOOD AVE. N.
MINNEAPOLIS, MINN.

Name.....

Firm Name.....

Address.....

City..... State.....

designers

and

builders

of

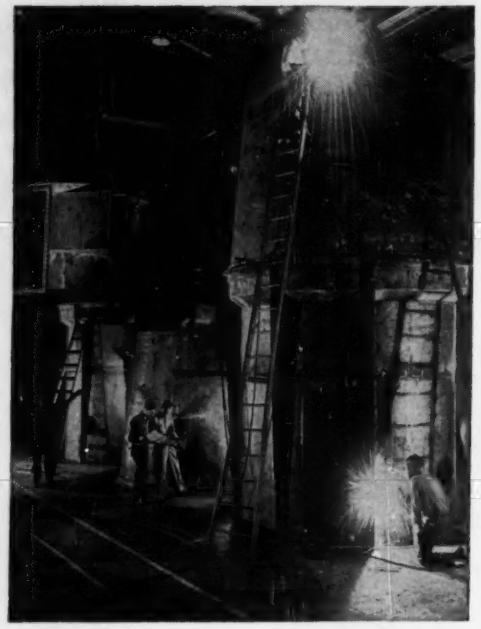
equipment

for

basic

industries

- Conveyor Systems for Petroleum Coke
- Autoclaves
- Special Valves
- Special Fittings



McNally WELDMENTS

AT plants in Ohio and Kansas, McNally Pittsburg is fully equipped to produce heavy weldments. Your equipment can be designed from your sketches; or built to your detail drawings. For one piece or a trainload, these plants are ready to serve you today.



McNally VALVES

FOR heavy duty or special duty, McNally Valves give accurate control and long life. The standard line includes: Abrasion resistant, Gate, Motorized Gate, Cock, Quick Opening, Check, Butterfly, Special valves made of Cast Iron, NiHard or Brass. Fabricated steel valves made to your specifications.

— Manufacturing Service —

Specification Cast Iron
Heavy Machining
Stress Relieving
Assembly
Platework
Structural Steel

Consulting Services without Obligation

WRITE for DESCRIPTIVE BULLETINS

MCNALLY PITTSBURG
MANUFACTURING CORPORATION

"Fifty Years of Knowing How"

Wellston, Ohio — Pittsburg, Kansas

LITERATURE . . .

Packings, Valve & Pump.....V-rings, cup and cone, and wedge type packings of chemical resistant pure teflon —engineered for greater flexibility and resiliency. Full information detailed in Bulletin TP-1053.
329 *U. S. Gasket Co.

Seals, Mechanical.....Combining chemically impervious teflon with a balanced bellows design—Chemiseal external mechanical seals last longer & give unsurpassed performance. Details in Bulletin No. MS-954.
340 *U. S. Gasket Co.

Seals, Mechanical.....Describes and illustrates company's line of Flexibox mechanical seals . . . for the process industries. Includes data on advantages, applications, capabilities, etc., in 12 p. Bulletin No. 10.
350 *Sealol Corp.

Seals, Mechanical, Rotary.....Company announces the availability of a new 8 p. reference which shows how you get maintenance-free sealing that slashes fluid mixing cost to a new low. Illustrated Bulletin B-111.
121e *Mixing Equipment Co

Transformers, Dry-Type.....Describes Allis-Chalmers totally-enclosed dry-type transformers with NEMA Group 3 class insulation for indoor or outdoor applications. Complete information in illustrated Bulletin 61B8222.
434A Allis-Chalmers Mfg. Co.

Turbines, Solid-Wheel.....Feature reliable, trouble-free operation. Rugged construction and superior design result in savings by keeping maintenance costs down to a minimum. Full details in Bulletin No. S-116.
42 *Terry Steam Turbine Co.

Handling & Packaging

Bag Closers.....Entirely portable—require no installation, supports or plant space—handle textile & paper bags—close average 100 lb. bag in less than 6 seconds—etc. Details in fully illustrated Folder.
434B Dave Fischbein Co.

Calcium Chloride Handling.....Illustrated, 18 p. tells how to establish, operate & expand facilities for bulk calcium chloride operations. "Recommended Procedures in the Bulk Handling of Calcium Chloride."
434C Dow Chem. Co.

Conveyors.....In any industry wherever dry bulk materials are used . . . the introduction of Airstream conveyors invariably leads to lower-cost materials handling. For full details, request 24 p. Bulletin 529.
123 *Dracco Corp.

Conveyors, Gravity & Power.....28 p. reference shows over a hundred pictures of Standard Conveyors & Pneumatic Tube installations & conveyor units in various types of industries. Request valuable Catalog, No. 309.
434D Standard Conveyor Co

Feeders.....Describes "Loss-in-Weight" Gravimetric feeders for dry materials. Includes advantages, description, operation, feed range, components, accessories, etc., in illustrated Bulletin 30-H12A.
434E Omega Mach. Co.

Loading Assemblies.....Two complete lines for faster, safer, more convenient liquids handling. Sizes, engineering data & specifications on a spring-balanced & counter-balanced loading assemblies in Catalog F-7.
25 *OPW Corp.

Materials Handling, Bulk.....One unit feeds, conveys, elevates thru horizontal, vertical or inclined planes—quickly, efficiently, economically. Request idea book on engineered materials handling systems.
TL351 *Gifford-Wood Co.

* See explanation on p. 422

Materials Handling, Bulk-Flo.....Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly. 28 p. Book 2475.
13 *Link-Belt Co.

Separators, Magnetic.....Illustrated, 16 p. contains information on company's magnetic separators and traps. Describes how they're made, how they work, the numerous advantages, maintenance, etc. Catalog No. M-554.
435A Emerson Mfg. Co.

Storage Systems, Slurry, Soda Ash..... Illustrated 16 p. Brochure explains how paper mills, steel mills, textile mills, etc. can effect economies in storing & handling soda ash in readily usable form as a slurry.
435B Diamond Alkali Co.

Trucks, Fork....."Facts About Fork Trucks—The Gas vs. Electric Question" presents an objective study of capabilities of gasoline & electric powered fork trucks operating under normal conditions.
435C Lewis-Shepard Products.

Trucks, Fork.....Illustrated Bulletin describes all the features, specifications & dimensions of the new Yale Warehouser Electric Truck with Extend-A-Forks. This feature permits stacking with no straddling of the load.
435D Yale & Towne Mfg. Co.

Trucks, Fork Lift.....Company announces the availability upon request of a brochure which describes the advantages of liquefied petroleum gas (LP Gas) power for industrial fork lift trucks. Illustrated, 4 p.
435E Clark Equipment Co.

Trucks, Hand.....New power-packed Stair Cart will speed operations, eliminate fatigue, reduce accidents with these 2 exclusive features: stair climbing power drive; 2 wheel safety brakes. Request illustrated Folder.
435F Valley Craft Products.

Trucks, Industrial.....Announces 8 p. condensed catalog illustrating and describing company line of power industrial trucks. Includes sections on Elpar fork trucks, high & low-lift platform trucks & crane trucks.
435G Elwell-Parker Elec. Co.

Trucks, Industrial....."Modern Material Handling" covers unit-load principle, power requirements of industrial trucks & characteristics of Edison nickel-iron-alkaline storage batteries. Fully illustrated. 32 p.
435H Thomas A. Edison, Inc.

Heating & Cooling

Boilers.....Describes "S" series of boilers. Complete data & specifications given on each of models & sizes in line, with capacities ranging from 10,800 to 50,000 lbs. of steam per hr. Illustrated Brochure WT-8.
435I WM. Bros Boiler & Mfg. Co.

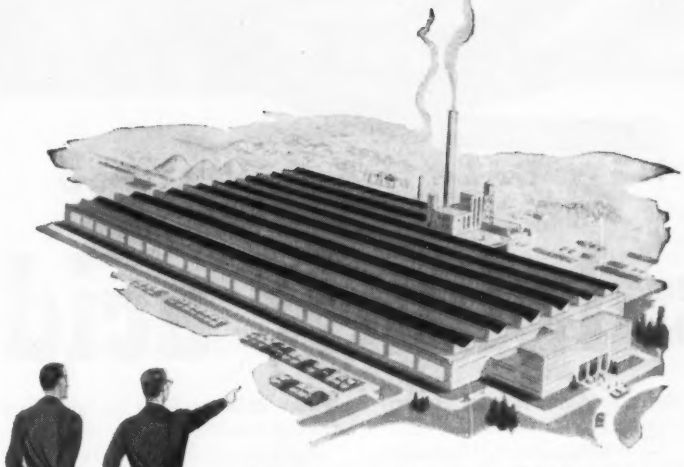
Boilers, Packaged Automatic.....Offer valuable features: low-cost, space saving installation; fast steaming; instant response to load changes; quick fuel change-overs; clean, dry steam; etc. Data in Bulletin 1220.
97 *Orr & Sembower.

Condensers, Evaporative..... Reference describes new design with a cutaway illustration & full construction details. Includes performance curves for selecting units to use with either freon or ammonia. Request Catalog No. 500.
435J Acme Industries.

Coolers.....Offers full physical specifications & complete application data on Angle-Air coolers, from which it is easy to select the proper unit for each refrigeration application. Request Tenney Bulletin No. 109-55.
435K Tenney Engrg.

* See explanation on p. 422

DO YOUR SCALES ADD UP TO A *Weighing System?*



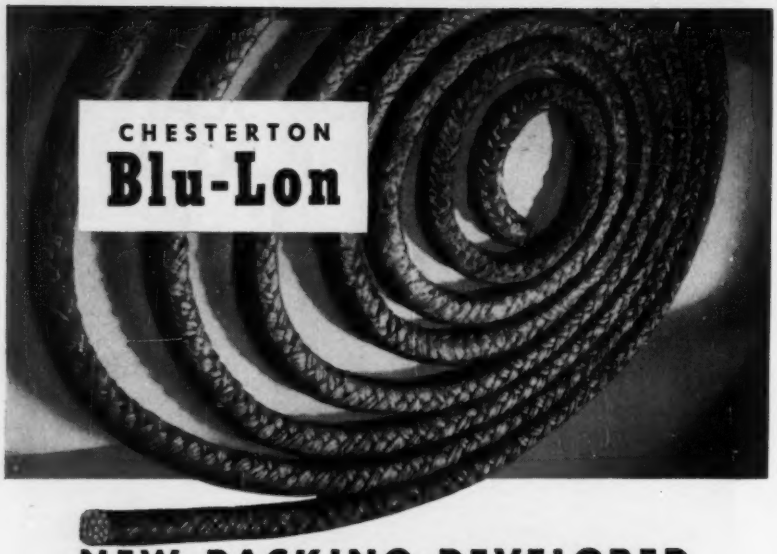


TODAY IT PAYS TO TAKE A PLANT-WIDE LOOK AT WEIGHING

Do you have the *right* scales in the *right* places? A modern *Weighing System* works hand in hand with your accounting *system* and makes a *big* difference in helping you win your war on costs. Weight records that originate at scales flow to the accounting areas and directly affect costs, inventories and customer billings. Weighing errors cannot be corrected later—weights must be right the *first* time. That's why it's more than ever important to think of weighing not in terms of isolated scales, but as a vital part of your overall cost-control system.

If you would like to explore this in relation to your plant, why not drop us a line today? No obligation, of course.
Ask about the "weighing system plan."
Toledo Scale Company,
Toledo 1, Ohio.





NEW PACKING DEVELOPED BY CHESTERTON FOR

sulphuric acid

Sulphuric Acid, Nitric, Hydrocloric, in fact on any Acid* Blu-Lon, Chesterton Style 320, makes a tight lasting seal. Blu-Lon is braided from chemically pure African Blue Asbestos and through a specially designed method each single strand is immunized and lubricated with DuPont Teflon. This process is not to be confused with other quick dip Teflon treatments as Blu-Lon is a thoroughly impregnated Teflon packing. This added protection plus Blu-Lon's unique breaking-in lubrication places this packing in an Acid resisting field by itself.

Chesterton Blu-Lon is recommended for strong acids of 1–4 pH value. Note chart below which recommends three Chesterton Packings for full range of chemicals 1–14 pH.

Blu-Lon comes thoroughly lubricated, *ungraphited*, blue in color. It is ideally suited for service on chrome plated or stainless steel shafts.

** For Hydrofluoric Acid write us for special recommendation.*

A pH SCALE FOR CHEMICAL PACKINGS

1 TO 4	5 TO 10	11 TO 14
pH VALUES	pH VALUES	pH VALUES
STRONG ACIDS	WEAK ACIDS OR ALKALIES	STRONG ALKALIES
#320	#315	#322
Blu-Lon	Carsons	White-Lon

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

LITERATURE . . .

Coolers, Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Request Catalog No. S-6820.
49e *National Carbon Co.

Exchangers, Scraped Surface.....Closed pressure-type systems which permit use of flammable, volatile and expensive solvents with greatest safety and no danger of solvent loss. Details in Bulletin No. PE-1.
56 *Henry Vogt Mach. Co.

Heat Exchangers.....B&G heat exchangers . . . for every type of service —type "OC" straight tubes—type "U" U-bent tubes—fuel oil pre-heaters—gas coolers—type "WU" water heaters. Request illustrated Catalog.
383 *Bell & Gossett Co.

Heat Exchangers..... Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to servere thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
49c *National Carbon Co.

Heat Exchangers.....In De Laval plate heat exchangers the plates are so designed as to produce strong turbulence and high velocity . . . achieving maximum heat transfer. Request Heat Exchanger Bulletin.
131 *De Laval Separator Co.

Heat Exchangers.....Specially designed stainless steel heat exchangers for heating or cooling liquids & gases as used in chemical & other industries where elements of corrosion to alloys are encountered. Catalog 1155.
436A Young Radiator Co.

Heat Exchangers.....New standardized heat exchanger design features lower first cost, more area per unit, choice of tube lengths, faster delivery, etc. Company offers full information in Catalog S-6840.
49d *National Carbon Co.

Heat Exchangers, Immersion.....Impervite plate & bayonet-type heat exchangers are impregnated, machined & fabricated all under one roof to assure maximum operating efficiency & long service life. Bulletin 753.
436B Falls Industries.

Heat Transfer Apparatus....."SK Heat Transfer Apparatus" furnishes valuable information on the various types of tube bundles. Special materials, sizes, types & modifications are all covered. Request Bulletin No. HT-1.
65 *Schutte & Koerting Co.

Heat Transfer Apparatus.....Describes Twin G-Fin Section as the universal heat transfer apparatus—operating with success as cooler, heater, condenser & heat exchanger for a wide range of fluids. Bulletin 1400.
164 *Griscom-Russell Co.

Heat Transfer Apparatus.....Votator heat transfer apparatus can improve efficiency and product quality in numerous processes. Company makes available a Heat Transfer Data Book containing complete information.
2 *Girdler Co.

Heaters, Gradiation.....Selas Gradiation Zone Control offers new possibilities in every chemical plant where heat processing is a precise operation. Provides complete information in a new 16 p. Booklet.
160 *Selas Corp. of America.

Heaters, Immersion.....Electric immersion heaters & controls for every application . . . acid heating—alkali heating. Covers advantages, construction, uses, installation, prices & ratings, etc. Bulletin No. 25.
436C Pyrosil, Inc.

Heaters, Immersion.....Releases valuable 24 p. reference, "Kemp Case Histories," which features installations of Kemp industrial gas equipment at seventeen major companies. Illustrated Bulletin No. G-10.
436D C. M. Kemp Mfg. Co.

* See explanation on p. 422

Heaters, Radiant.....Describes multiple uses & added efficiency of Clepco Quartz Radiant Heaters. Illustrates the various shapes & sizes and the application to your baking & drying jobs. Request Bulletin No. 100.
437A Cleveland Process Co.

Platecoils.....Designed for tank heating and cooling problems due to inefficient pipe coils. These cost-saving platecoils heat or cool 50% faster and take 50% less space in the tank. Offers Bulletin No. P61.
44 *Tranter Mfg.

Tubes, Condenser.....If stress corrosion cracking is costing you money and loss of production—ask Bridgeport Technical Service to analyze the factors involved. Makes available 165 p. Condenser Tube Handbook.
53 *Bridgeport Brass Co.

Instruments & Controls

Analyzers, Gas.....Infrared gas analyzers designed for plant analyses of gas compounds in multi-component streams. Feature no moving parts—no lenses—no mirrors. Information in Demonstrator ND46-91(1).
92 *Leeds & Northrup Co.

Control, Coordinated.....Coordinated control helps reduce cost of high pressure ammonia plant. Fully illustrated Composite Catalog No. 5002 provides a condensed description of complete Honeywell product line.
94-5 *Minneapolis-Honeywell.

Control Drives.....New, small, piston-operated Bailey control drive will improve flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders & similar regulating devices. Request Spec. CA040.
83 *Bailey Meter Co.

Controllers, Indicating.....Series 540 "On-off" indicating controller . . . is a rugged, durable & accurate remote indicating temperature control instrument designed for general industrial use. Illustrated Bulletin MC122.
66a *Fenwal, Inc.

Controllers, Indicating.....Offers data on new Series 560 controller . . . with revolutionary thermistor principle of operation for kilns, ovens, furnaces, extruding, air heaters, etc. Features & specifications. Bulletin MC123.
66b *Fenwal, Inc.

Controls, Level.....Tektor level control indicates or controls level of fluids, powders, solids (conducting or non-conducting). Features low first cost . . . low operating cost. Request descriptive Bulletin.
333a *Fielden Instrument Div.

Controls, Liquid Level.....Designed to give rugged, trouble-free service. High in sensitivity & accuracy—versatile in handling all kinds of liquids, with minimum service attention. Details in Bulletin No. F-3.
239 *Fisher Governor Co.

Controls, Temperature.....Designed to control and indicate temperatures of gases, liquids or hot plates over wide ranges. Typical applications, outstanding features, engineering data, etc., in Bulletin No. 42.
437B United Elec. Controls Co.

Gages.....Profusely illustrated, 132 p. describes Ashcroft gages—indicating & recording—for pressure, vacuum or compound services. Also covers gage testers, mercury columns, "U" gages, etc. Request Catalog No. 300A.
437C Manning, Maxwell & Moore.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Provides complete information in Gage Catalog No. G-2.
358 *Helicoid Gage Div.

* See explanation on p. 422

Now-partlow designs

"VEST-POCKET"

explosion-proof controls for hazardous locations

Vest-pocket price! Vest-pocket size!

U. L. APPROVED
-- for Class I, Groups C and D;
Class II, Groups E, F, G

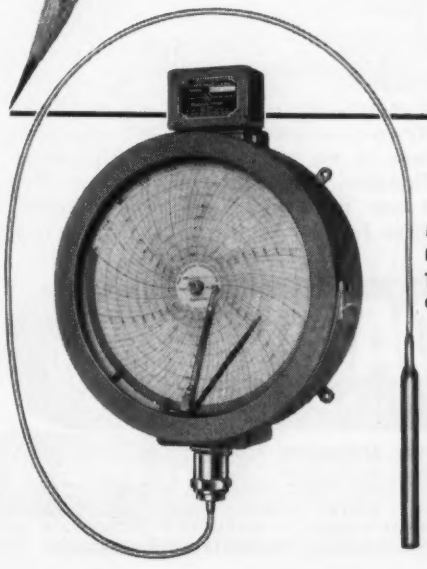
partlow

the pioneer in mercury thermal controls

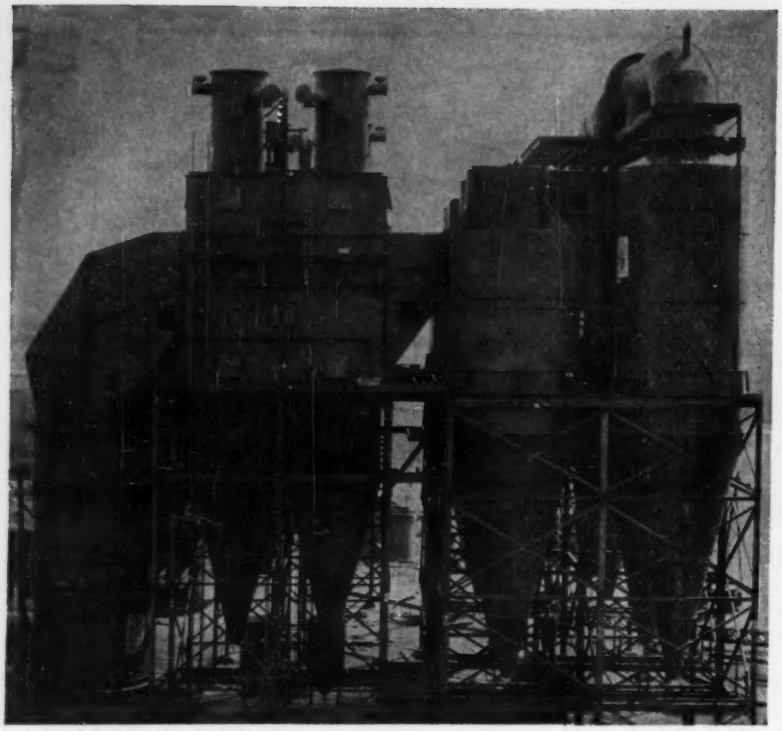
Offices in All Principal Cities
THE PARTLOW CORP., NEW HARTFORD, N. Y.

WRITE NOW
FOR MONEY-SAVING FACTS

on Partlow Indicating, Non-Indicating and Recording Explosion-proof Temperature Controls. One low cost . . . no large, heavy *extra* enclosure to buy or make room for.



Model RVS
Recording
Temperature
Control



CARBON BLACK PROCESSING

detail designed and fabricated by BOARDMAN OKLAHOMA CITY

This carbon black unit, shown during field erection, was fabricated many miles from the site; yet it assembled easily into a working unit. That's because BOARDMAN has had 44 years of experience in the type of detail designing and precision fabricating required for such results. During these years, every type of metalcrafting problem—both large and small—has been solved by BOARDMAN's metal fabricating "know-how". Make it your policy to consult BOARDMAN for all wrought iron, mild steel, stainless steel, clad steel and aluminum fabricating.

WE CHALLENGE YOU

On your next metal fabricating job, ask our Chief Engineer to fly to your plant for on-the-spot consultation. There is no cost to you, and you're under no obligation. We want you to accept this challenge at our expense. Telephone COLLECT today—or write for our metal products catalog.

THE BOARDMAN CO
P. O. BOX 1152 • OKLAHOMA CITY, OKLAHOMA

METAL FABRICATING SPECIALISTS FOR MORE THAN 40 YEARS

PRESSURE VESSELS INCLUDING A.S.M.E. CODE VESSELS • BATCHERS • BINS • BURNERS • COLLECTORS • CONVEYORS • DRYERS • DUCTS • ELEVATORS • FANS • FEEDERS • FIRE TRUCKS • FLUES • HOPPERS • MIXERS • ROASTERS • SPOUTING • SMOKESTACKS • STERILIZERS • TANKS • TRANSPORTS • WASHERS

LITERATURE . . .

Gages, Beta.....For the continuous measurement of weight per unit area or thickness of sheet or strip without physical contact. Literature includes a complete description plus data on performance and operation.
438A Curtiss-Wright Corp.

Gages, Liquid Level.....Presents valuable data on liquid level gages: reflex; thru vision; tubular. Standard equipment in leading refineries and industrial plants all over the world. Complete Catalog on request.
R353 *Strahman Valves

Gages—Recorders—Testing Instruments.....Illustrated, 68 p. includes data on line of indicating gages for refining, chemical & process industries, & for power plant & general industrial service. Catalog No. 500.
438B Crosby Steam Gage & Valve Co.

Indicators, Electronic Level.....For accurate, continuous level measurement of liquids or divided solids. Feature savings in initial cost and in maintenance. Complete new instrument information available.
333b *Fielden Instrument Div.

Meters.....Describes the Alnor Velometer—a precision-built, self-contained, portable instrument which gives instant, accurate readings of air velocities anywhere. Full details in Bulletin No. 2448-G.
R349 *Illinois Testing Labs.

Meters.....Helpful booklet covers 150 industrial liquids, including water, syrup, liquid sugar, cocoa butter, cocoanut oil, chocolate, flavors, coffee, wine, alcohol, etc. Complete data in Bulletin No. 566-V.
417 *Neptune Meter Co.

Meters.....Type 316 stainless steel meter for corrosive liquids . . . is answer to many measurement problems in food, chemical, drug & industrial processing fields—it resists corrosion. Bulletin No. OG-406.
393 *Rockwell Mfg. Co.

Meters, Electricontact.....Now—explosion-proof—a new Niagara electricontact meter . . . for automatically measuring and controlling liquids in hazardous atmospheres. Complete details in Bulletin No. 33.
345 *Buffalo Meter Co.

Proportioning, Automatic.....Furnishes information on Richardson's automatic proportioning systems. Includes complete case history file of Select-O-Weigh installation in industry. Illustrated 28 p. Bulletin 0351.
272 *Richardson Scale Co.

Recorders, Multi-Point.....Feature simplified design, circuitry and construction. The chart mechanism is rugged, but so simple in form that there is little or no maintenance. Request detailed reference.
333e *Fielden Instrument Div.

Recorders, Temperature.....Newly designed Model "1000" Auto-Lite recorder gives permanent proof of temperature behavior. Request valuable catalog describing the many styles of recorders and indicators.
TR355 *Electric Auto-Lite Co.

Recording Systems, Oscillographic..... From lathe cutting forces to telemetered aircraft data . . . Sanborn oscillographic recording systems prove their versatility. Catalog & technical data upon request.
360 *Sanborn Co.

Spectrophotometers.....Versatile and accurate, the G-E spectrophotometer has a range of 380 to 700 millimicrons. Instrument will measure both transparent and opaque samplings. Data in Bulletin No. GEC-307.
167 *General Elec. Co.

Telescopes, Industrial.....A. C. M. I. Borescopes permit close-up visual examination of interior areas & surfaces not otherwise visible. They save time & money & prevent costly dismantling. Request Folder.
TL353 *American Cystoscope Makers.

* See explanation on p. 422

Iron Contamination no problem here!



FERROFILTER

Magnetic Separators

are used by Stupakoff Ceramic & Manufacturing Company to remove iron particles from talc and clay used in the manufacture of electronic parts. The company takes this important step to guard the high quality and uniformity of their ceramics in critical applications.

Here, a 68V FERROFILTER has been mounted on rails to permit discharge of cleaned material to selected locations. Frantz Dry FERROFILTERS are also offered for suspended mounting. Available in two sizes with capacities from 1 to 25 tons per hour. Fully enclosed eccentric-weight vibrator speeds flow of material.

Send for BULLETIN 16-E

Shows complete line including Gravity, Pipeline and Underfeed models for liquids and slurries. Tables of sizes and capacities help you select the right one for your job.



S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.

P. O. Box 1138 Trenton 6, N. J.

REDUCE CYLINDER HANDLING

Up to 50% with INDEPENDENT Gas Supply Trailers!

Here's the newest idea in gas service! Leave a full gas trailer with your customer . . . replace it with another when empty. Reduces cylinder handling up to 50%... cuts cylinder costs . . . gives customers the convenience of having uninterrupted gas supply.

Many gas manufacturers and haulers of compressed gas (including many government agencies), are already enjoying the many advantages of INDEPENDENT Gas Supply Trailers.

Available for all gases as authorized by ICC.



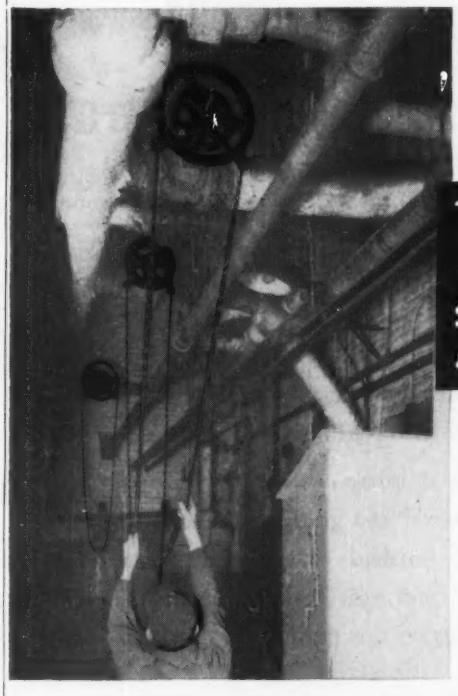
INDEPENDENT ENGINEERING COMPANY, Inc.

CONSULTING · RESEARCH · DESIGNING

Manufacturers of CYLINDERS AND GAS PRODUCING EQUIPMENT ACETYLENE · OXYGEN · HYDROGEN · NITROGEN

O'FALLON 7, ILLINOIS

We Invite Your Inquiries



Every Valve Easily Accessible with

Babbitt *—Adjustable—* SPROCKET RIM *with Chain Guide*

NEWLY REDESIGNED for greater strength—easier, quicker, more solid assembly.

- **Simplifies pipe layouts**
- **Fits any size valve wheel**
- **Prevents accidents**

Your supplier carries complete stocks. Call him — or write for details and prices.

Babbitt STEAM SPECIALTY CO.

5 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS, U. S. A.



...ANOTHER BRAND NEW

KERRIGAN SERVICE TO INDUSTRY

STAINLESS STEEL Grating and Stair Treads — new boon to industries where grating must withstand acids and corrosion! KERRIGAN *Weldforged* Grating — one-piece, inseparable units, made in all types A.I.S.I. and S.A.E. Standard Stainless and heat-resisting steels and electronically resistance welded to stand up under the severest kind of punishment AND FABRICATED TO BE FREE OF ANY "ACID-TRAP" RIVETS OR NOTCHES!

Kerrigan also offers you a complete *custom* service: shop drawings are sent for your approval and grating is fabricated to your exact specifications (with finished grating match-marked for easy installation). Let us send you detailed information. We shall welcome your inquiries on this new Stainless Steel Grating.

Write to

KERRIGAN IRON WORKS, Inc.

General Sales Office — 274 Madison Ave., New York City

LITERATURE . . .

Thermometers, Dial Indicating & Recording.....Offers specialized line of equipment for recording & indication of temperature & pressure to fill your requirements on many specific applications. Illustrated, 8 p.
440A Electric Auto-Lite Co.

Thermometers & Temperature Indicators.....Fully illustrated, 100 p. describes American line—industrial glass, dial & recording—mercury, vapor pressure, gas, bi-metal & thermocouple actuation. Catalog 100.
440B Manning, Maxwell & Moore.

Valve Operators.....Functional design & durable materials of construction of operators insure their long, dependable service—with always an immediate response to positioning force. Illustrated Bulletin 109-A.
440C Hammel-Dahl Co.

Viscosity Control..... Describes the Brookfield Viscometran . . . for continuous indication, recording & control of viscosity under process conditions. Includes principle of operation & advantages. Fully illustrated.
440D Brookfield Engrg. Labs.

Pipe, Fittings, Valves

Elbows, Long Tangent.....Feature many advantages: save pipe; often eliminate short nipples and their extra welds; save time and money in lining up and clamping pipe and fitting; etc. Catalog No. 54.
309 *Midwest Piping Co.

Fittings, Pipe.....Presents newest catalogue of stainless steel pipe fittings which shows all standard pipe fittings and flanges, flanged fittings, butt weld fittings, etc. Request fully illustrated Catalog No. 6[illegible].
R357a *Camco Products.

Fittings, Stainless Steel.....Three good reasons for purchasing Cooper Alloy stainless steel fittings—availability (quick—when you need it) . . . superior quality . . . complete line. Request Bulletin No. 0100.
78b *Cooper Alloy Corp.

Fittings, Stainless Steel.....Offer entirely new concept of fitting design & fabrication—much greater speed & ease of installation—savings in original investment cost—etc. Details in new Bulletin No. 1055.
301 *Tri-Clover Div.

Fittings, Stainless Steel....."Newscast" contains case histories showing how Quikupl—stainless steel fitting which can be assembled and disassembled without threading, flaring or welding—cuts time and costs.
78c *Cooper Alloy Corp.

Flange Specifications.....Company announces the development of a new Flange. Specification table for ASA and MSS Flanges in a convenient, slide rule form. Pocket-size reference is available upon request.
R357b *Camco Products Co.

Joints, Expansion.....Rubber expansion joints are flexible, rubber connections, installed in pipe lines for the purpose of relieving stresses & strains in the piping & equipment. Details in illustrated, 8 p.
40E Garlock Packing Co.

Pipe & Fittings..... For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Request Catalog No. S-7000.
49b *National Carbon Co.

Pipe & Fittings, Glass.....Glass pipe & fittings for full-scale production operations. Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3 offer full details.
254-5a *Corning Glass Wks.

* See explanation on p. 422

You gotta be first...
to be best!*



*25 years ago, Alloy Fabricators started to build Stainless Steel, Monel, Inconel, Nickel and Aluminum Process Equipment. With this experience, naturally, they're your *best bet today!*

It's Still Our Only Business — And We Mind It Well!

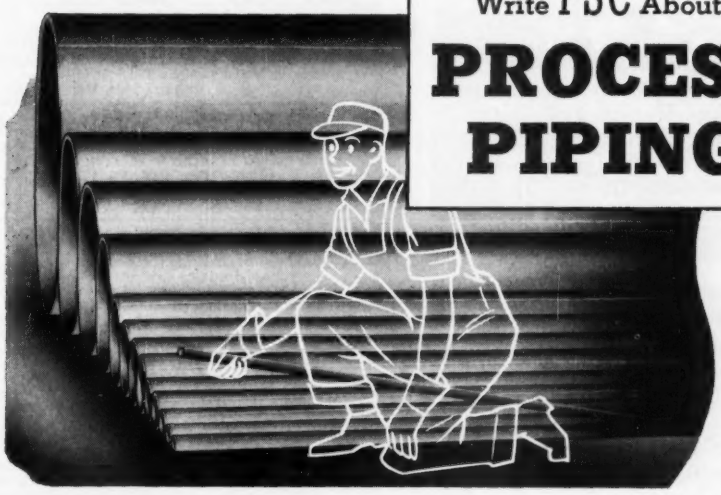
ALLOY FABRICATORS

DIVISION OF CONTINENTAL COPPER AND STEEL INDUSTRIES, INC.

PERTH AMBOY, NEW JERSEY

Write PSC About

PROCESS PIPING



Fabricated from Complete Range of Alloys, Any Diameter Up to 60", and in Any Shape

PSC welded process tubing is furnished in any alloy whatsoever. This feature accounts for its wide application in meeting the unlimited variety of heat, corrosion, oxidation conditions in process plants.

Any diameter up to 60"; wall thicknesses to 3/8"; temperatures to 2200°. Precision fabrication of tubing assemblies is a specialty. Send b/p or write as to your needs.

THE PRESSED STEEL CO., 707 N. Penna. Ave., Wilkes-Barre, Pa.

Custom Fabricators for the Process Industries Since 1928. Send Your Blue Prints

---

CHEMPRO
makes them all in Teflon!



RING TYPE PACKINGS



ASBESTOS PACKINGS



V-TYPE PACKINGS



FLEXIBLE SEAL CAGES



JACKETED GASKETS



SOLID RING GASKETS

CHEMICAL & POWER PRODUCTS, INC.
5 Broadway, New York 4, N.Y.

Check the Bulletins you want:

- ☐ Packings & Seal Cages
- ☐ Gaskets
- ☐ Teflon Stock & Special Molded and Machined Parts

Name_____

Company_____

Street_____

City_____ State_____

A PUMP PACKING THAT'S EXPENSIVE, BUT *CHEAP!*



Lasts at least 3 times longer than ordinary pump packings

Frankly, the service reports on LATTICE BRAID asbestos packing with Teflon surprised us! Originally designed and test-proven for use against severe acids, caustics, and other chemicals, this particular packing has out-performed other packings (*even our own*) on more common applications against water, steam, solvents, and oils.

And here's why: (1) The LATTICE BRAID construction gives greater strength; (2) The Teflon core and heavy Teflon impregnation resist everything except molten alkali metals and some freons; (3) It does not adhere to the shaft or rod; (4) It runs smoother and freer than packings without Teflon.

Check these typical service reports:

- Against blending waxes and steam (for cleaning). it outlasted another Garlock style 10 to 1
- Against caustic at 325°F., 50 p.s.i., it outlasted competitive packing 38 to 1
- Against cold water, it out-performed other packings 3 to 1

LATTICE BRAID with Teflon is available in either Canadian white asbestos (style 5861) or blue African asbestos (style 5880). Each is furnished in packing sizes 5/16" to 1½" graduated by sixteenths.

Try an order of 10 feet or more today. Chances are you can *reduce* down-time, maintenance and replacement costs to *one-third* of their present amount.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo Chicago • Cincinnati • Cleveland • Denver • Detroit • Houston Los Angeles • New Orleans • New York City • Palmyra (N.Y.) Philadelphia • Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*Registered Trademark †The Du Pont Company's Trademark

GARLOCK LATTICE BRAID with TEFLON

LITERATURE . . .

Pipe & Fittings, Polyvinyl Chloride Furnishes information on ¼" to 4" line of normal impact & high impact unplasticized polyvinyl chloride pipe & fittings, plus properties & characteristics data, etc .
TR431 *Alpha Plastics.

Pipe Installation, Glass.....Pipe is easy to install & low in installed cost compared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch. I. D. inclusive. Installation Manual No. PE-3.
254-5b *Corning Glass Wks.

Pipes, Shower.....Simple, mechanical, cleaning action assures the ultimate in constant, uniform spray pressure & cleaning efficiency coupled with the minimum in water consumption. Details in illustrated, 6 p. Folder.
442A Emerson Mfg. Co.

Valves.....Keeping corrosive solutions of mineral & organic acids, alkalies & salts under control is a job for Aloyco Monel or Nickel valves. Both alloys available in wide range of valve designs. Bulletin No. 9.
93 *Alloy Steel Products Co.

Valves.....Company makes available popular entertaining pamphlet, "The Fox & the Hare," presenting a story about the recognition of Balanseal valves. It is humorous & enlightening. Request your free copy.
50-1b *Farris Engrg. Corp.

Valves.....New Crane corrosion-resistant valves in 18-8 SMo and Craneloy 20—gate, globe, angle and check patterns. Both lines come with screwed or flanged ends. Full information given in Circular AD-2080.
277 *Crane Co.

Valves, Blow-Off.....Drop-tight—rugged and dependable—easy to maintain. Request Blow-Off Valve Check Sheet, new Blow-Off Valve Catalog B-426 (pressures to 400 psi) and Catalog B-434 for higher pressures.
41 *Yarnall-Waring Co.

Valves, Bronze.....Covers OIC 500 line —modern 200 lb. bronze valves. Includes features, service recommendations, working pressures, etc. for globe & angle valves—horizontal & angle checks. Form No. 1001.
285 *Ohio Injector Co.

Valves & Fittings.....Makes available a preprint of technical data section of forthcoming Valve & Fitting Catalog. Includes diagrams, design information, cutaway photos, selection, maintenance & repair hints, etc.
78a *Cooper Alloy Corp.

Valves, Gate.....Offers data on sturdy, small forged steel gate valves. Superhardened gate and seats assure tight closure, smooth operation and low maintenance. Complete information in Catalog No. 10.
58 *Chapman Valve Mfg. Co.

Valves, Globe.....Design and construction of valves dictated solely by requirements for the handling of chemicals. Ruggedness, quality & low maintenance costs featured. Request illustrated Bulletin H-2.
275 *LaBour Co.

Valves, Instrument.....Describes the 6000# Hancock stainless steel instrument valve . . . a new high pressure valve for use on instrument panels, instrument lines, gauge lines, by-pass lines, etc. Bulletin 230.
442B Manning, Maxwell & Moore.

Valves, Lubricated Plug.....ACF cylindrical lubricated plug valves—with rectangular or round port openings—feature "split-second" shut off, teflon head gaskets & many other design advantages. Catalog 7-CM.
159 *ACF Industries

Valves, Lubricated Plug . . . . . Powell Valves—the complete quality line—offer many outstanding features in new lubricated plug valves, such as quick & sure operation & a positive seal when valve is closed. Full data.
45 *Wm. Powell Co.

* See explanation on p. 422

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications.
307 *Lapp Insulator Co.

Valves, Pump.....Keep pumps fit—with valves that fit all pumps. Durabla pump valves will operate freely under extremes of high or low temperature, with highly corrosive fluids & in any position. Request Bulletin.
347 *Durabla Mfg. Co.

Valves, Safety.....Fully illustrated, 16 p. furnishes detailed information on Crosby line of high capacity safety valves. Describes operating features, sizes, pressure-temperature limits, etc. Catalog No. 400-HC.
443A Crosby Steam Gage & Valve.

Valves, Safety Relief.....The ultimate in nozzle valve construction with complete standardization and interchangeability in every part. Offers Catalog 48Ra covering product line and Technical Manual 51B.
50-1a *Farris Engrg. Corp.

Valves, Sanitary & Industrial.....Fabricated, quick-acting, seatless valve combines ruggedness of globe valve, cleanliness of plug valve & flow characteristics of gate valve. Describes features in illustrated, 4 p.
443B Hurt Corp.

Process Equipment

Absorbers.....For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information offered in Catalog No. S-7460.
49f *National Carbon Co.

Agitating Equipment.....Fully illustrated, 50 p. covers: Model WT Agitator Drive; Model T & TA Agitator Drives; Model TB & TAB Agitator Drives; Model No. 3 Agitator Drive; Flomix; etc. Request Catalog No. 530.
443C New England Tank & Tower.

Agitators, Side Drive.....Presents 8 p. fully illustrated reference covering Nettco side drive with shut-off. Describes how the shut-off operates, numerous advantages, exclusive features, etc. Bulletin No. 532.
443D New England Tank & Tower.

Blenders.....Day blenders are available in capacities from one cubic foot to 2300 cubic feet. Plain, galvanized or stainless steel tanks. Jacketing is optional. For complete details, request illustrated Bulletin 800.
354 *J. H. Day Co.

Centrifuges.....High speed dehydrating centrifuge offers precise external control of variations in flow rate, crystal size & slurry concentration & permits intermediate treatment of crystals. Bulletin No. 1257.
133 *Sharples Corp.

Collectors, Multi-Wash.....For the efficient removal of air-borne contamination (dust, fumes, vapors, acid gases and odors) and recovery of product tru multiple washing action. Bulletins Nos. 551 & 610.
BL349 *Claude B. Schneible Co.

Crushers, Jaw.....Illustrated, 24 p. booklet offers complete information on company's line of jaw crushers. Built in eight sizes with capacities up to 300 tons per hour. Details available in Bulletin No. 1124.
29e *Traylor Engrg. & Mfg. Co.

Crystallizers, Vacuum.....8 p. booklet describes Swenson crystallizers—individually engineered for minimum cost, maximum recovery of crystals, top quality of product. Request illustrated Bulletin No. C-100.
273a *Swenson Evaporator Co.

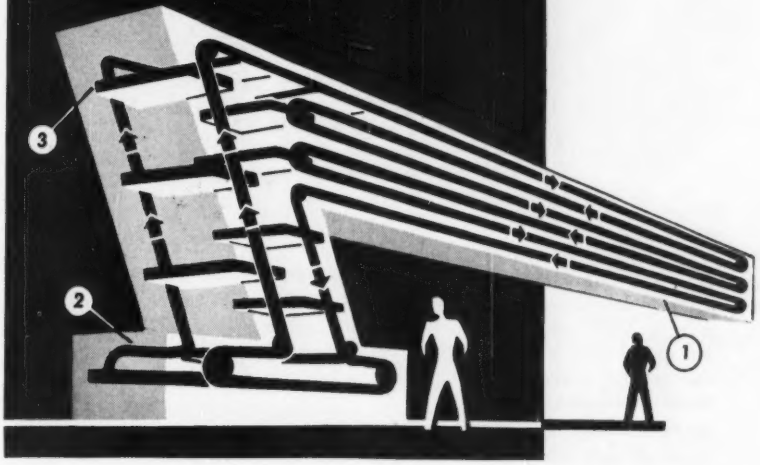
* See explanation on p. 422

Now COOL, HEAT or DRY your products in a fraction of the floor space with a GREER MULTI-TIER

. . . because a MULTI-TIER provides 100 to 1000 feet of cooling, heating, or similar processing travel in floor space as small as 15 feet.

Gives you 10 minutes to 10 hours of overhead processing travel with exact time, temperature, and atmospheric control.

In one application alone, Multi-Tiers replaced three men, boosted production, in one-third the floor space.



1. Saves floor space — ample headroom.
2. Conveys products through controlled processing cycles without jar or jolt. Automatic or manual loading and unloading. Easily enclosed to meet wide range of cooling or heating requirements.
3. Trays always perfectly level. Custom fitted to your products.



WRITE 8-page bulletin tells how a Multi-Tier can save you time, labor, and floor space. Send for your copy.

J. W. GREER COMPANY

Wilmington, Massachusetts

Sales Engineering Offices: Chicago, Ill., San Francisco, Calif.

GREER

TESTS PROVE **NEW** EASY-TO-APPLY

RUSTBOND PRIMER #6

LENGTHENS **ANY** TOPCOAT LIFE



These test panels of rusty steel were coated at the same film thickness and exposed side by side in a highly corrosive atmosphere (35% hydrochloric acid vapors) for the same length of time. Coatings on both panels were identical, with one exception: primer on left panel was new Rustbond #6, that on right was a popular competitive primer. In both cases, the topcoat was the same *well known competitive brand.*

As this unretouched photo shows, the sharp edge protection of the panel at right has completely failed, while the panel primed with Rustbond #6 shows practically no edge failure.

You can get improved performance like this from *any* topcoat—vinyl, phenolic, alkyd—with Rustbond #6 as the primer.

Rustbond #6 offers you these advantages:

- **Dries in only 10 minutes at 85°F., 15 minutes at 70°F., reducing application time and cost.**
- **Can be applied over wirebrushed rusty steel or bright shiny steel.**
- **All-purpose primer, especially resistant to *acids* and *alkalies*.**
- **Excellent shop coat because of easy application and high resistance to weathering.**
- **Can be brushed, sprayed, hot sprayed or roller-coated without webbing.**

TRY IT YOURSELF

We will furnish a free sample of Rustbond Primer #6 for your own similar testing. Advise atmosphere, type of surface and topcoat involved. Write today.

carboline COMPANY

A Division of Mullins Non-Ferrous Castings Corporation

Specialists in Corrosion Resisting Synthetic Materials

337 Thornton Ave., St. Louis 19, Mo.

LITERATURE . . .

Demineralizers, Permanent Cartridge..... Low cost, mineral-free water in quantities up to 10 gals./hr. Operation is simple & foolproof & maintenance is low. Flow meter offers valuable advantages. Illustrated, 6 p.
444A Penfield Mfg. Co.

Discs, Rupture, Safety Head.....Developed for low pressure applications of a type, which, because of extreme corrosive conditions, cannot be handled by the standard pre-bulged type of disc. Complete literature.
337 *Black, Sivalls & Bryson.

Dissociators, Ammonia ..... Illustrated, 12 p. offers valuable information; typical uses of dissociated ammonia; description of dissociator; economy; advantages; sizes-capacities; users of equipment; etc. Bulletin B-52.
313 *Drever Co.

Dryers.....Lectro-dryers can dry air & gases in volume to dewpoints below —100°F—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
47 *Pittsburgh Lectrodryer Corp.

Dryers, Rotary.....Deliver top production, exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems, in illustrated, 12 p.
368 *Standard Steel Corp.

Dryers, Rotary ..... The Davenport rotary hot air dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten. For complete details, request Catalog A.
BL433a *Davenport Mach. & Foundry.

Dryers, Rotary Vacuum.....Company announces the availability of literature on their vacuum drying equipment (Catalog No. 720) and a new reference covering Stokes Laboratory facilities (Bulletin No. 640).
359 *F. J. Stokes Mach. Co.

Dryers, Spray.....Literature on research spray dryer—describes and illustrates Swenson's completely packaged spray dryer for laboratory and pilot plant operations. Request informative Bulletins Nos. D-105 and D-106.
273b *Swenson Evaporator Co.

Drying Equipment.....To improve your product call on Proctor & Schwartz, who not only manufacture drying equipment, but have the know-how to help you in materials handling problems. Request Bulletin 390.
418 *Proctor & Schwartz.

Drying Systems, Flash.....Systems offer means for handling materials in which drying is combined with pulverizing, or with mild distintegration, or followed by cooling & conveying product to storage. Catalog 54-A.
326 *Raymond Div.

Dust Control ..... Pangborn engineers help solve your dust problems—line of wet or dry dust collectors can save time, trouble & money. See how varied industries are benefited in "Out of the Realm of Dust."
334 *Pangborn Corp.

Evaporators.....Booklet on long-tube vertical evaporators—describes high capacity, steam-saving evaporators for concentrating mobile & foamy liquids & heat-sensitive materials. Illustrated Bulletin No. E-100.
273c *Swenson Evaporator Co.

Filter Fabrics.....The right fabric adds efficiency to continuous operation. Announces availability of a full illustrated booklet, "Filter Fabric Facts," describing filter fabric development and application.
156 *Wellington Sears.

Filters, Horizontal Vacuum.....Bird-Prayon continuous, rotary, horizontal vacuum filter combines: super efficient multi-stage washing; high operating efficiency; low operating cost. Bulletin BP-2-55-5M.
444B Bird Mach. Co.

* See explanation on p. 422

Building up files?

Then you can cash in right now on our new, comprehensive Guide to Technical Literature in this issue. There you'll find a checklist of the current and latest literature on any topic in your field — easy to get, too.

Filters, Pressure.....Covers high capacity, high efficiency, horizontal tank, vertical leaf filter designed for maximum ease & speed of operation at lowest operating & maintenance cost. Bulletin PF-2-55-5M.
6 *Bird Mach. Co.

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Find complete details in Catalog No. NC-1-53.
324 *Niagara Filters Div.

Filters, String Discharge.....String Discharge handles almost any type of cake . . . thin, soupy slimes . . . heavy or coarse granular materials . . . or sticky gels. Details in illustrated Technical Bulletins.
330 *Filtration Engrs.

Filters, Top-Feed.....Furnishes an illustrated folder describing Swenson's efficient, money-saving top-feed filter equipment that dewaters and dries crystalline materials in one process. Bulletin No. F-101.
273d *Swenson Evaporator Co.

Kettles, Jacketed Grease.....Buflovak jacketed grease kettles engineered for specific process requirements . . . to fit specific processing operation needs . . . to provide profitable performance. Catalog No. 356-R.
46 *Blaw-Knox Co.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
29a *Traylor Engrg. & Mfg. Co.

Mills, Ball.....A steel-head ball mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Bulletin No. B2-B13.
420b *Denver Equipment Co.

Mills, Colloid.....Operate at speeds approaching the theoretical minimum required for true wet micro grinding —shaft speeds up to 10,000 rpm depending on size and type of mill. Offers descriptive literature.
BR396 *Admiral Tool & Die Co.

Mills, Grinding.....Mills applicable for wet or dry, coarse or fine grinding. Assure a uniform product of desired fineness. Improved design and construction features fully described. Illustrated Bulletin No. 8121.
29b *Traylor Engrg. & Mfg. Co.

Mills, Hammer, Reversible.....Double service from hammers, breaker plates & grate bars—maintenance reduced to half or less—downtime cut as much as 50%—etc. For details of valuable features, request Catalog.
99a *Williams Patent Crusher.

Mills, Tube.....Designed to meet specific needs. Availalbe from 2-10 ft. in diameter; 6-35 ft. in length; single or multiple compartments; with acid proof lining of rubber, silica & porcelain. Bulletin 18-B-11.
414 *Hardinge Co.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
121a *Mixing Equipment Co.

* See explanation on p. 422

Want better gate valve service?



Cutaway, showing the simple and unique Darling fully revolving double disc gate valve principle that equalizes disc and seat wear, compensates for valve body distortion and provides prolonged tight closing.

IN *your* service Darling gate valves will offer you many times the customary number of operating cycles before repair or replacement is necessary.

It's the unique Darling *fully revolving double disc parallel seat* principle that does it. Get all the facts and see how you save on down-time, part replacement and maintenance.

Darling offers these gate valves in sizes, types and metals for all kinds of normal and unusual services. Write for details, specifying your service requirements.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES

"NETONE" Filter Paper

- HIGH TENSILE STRENGTH
- HIGH BURST FACTOR
- ABRASION RESISTANT
- CREASE RESISTANT
- CHEMICAL RESISTANT

"NETONE" Filter Paper is a neoprene impregnated kraft paper that offers decided mechanical and chemical advantages over standard filter papers.

When compared to 60-pound unbleached kraft "NETONE" Filter Paper shows a 500% increase in wet tensile strength, wet burst factor increases from 6 to 57 and there is a marked increase in abrasion and crease resistance.

The following are a few test results indicating comparative resistance factors.

Solution	60-Pound Kraft	Wet Strength Resin	Neoprene Treated (3%)
H_2O	0	72 hr.	86 hr.
10% HCl	0	6 min.	4 hr.
10% NaOH	0	6 hr.	72 hr.

Write us about your requirements and we will be glad to send samples for your testing.

... And for your filter cloth requirements we weave fabrics of VINCEL*, Saran, Nylon, ORLON**, Glass, VINYON N†, TEFLON††, DACRON*** and Polyethylene. Samples sent on request.

* TM—NFM Reg. U.S. Pat. Off.
** TM for Du Pont acrylic fiber
*** TM for Du Pont polyester fiber
† TM—Union Carbide and Chemical Co.
†† TM for Du Pont tetrafluorethylene fiber

Weavers of Industrial Filter Media for over Forty Years

NFM **The National Filter Media Corp.**

General Offices & Mills: New Haven 14, Conn.
Western Office & Factory: Salt Lake City 2, Utah

Sales Offices—Representatives

Los Angeles, Calif. 811 West 7th St.
Chicago, Ill. 2627 West 19th St.
Cincinnati, Ohio Roselawn Center Bldg.
Houston, Texas 1503 Hadley St.
Oslo, Norway Nicolai Friis
Johannesburg, South Africa Edward L. Bateman

LITERATURE . . .

Mixers.....Data on turbine & slow speed heavy duty agitators . . . for open & closed tanks. Covers operation & applications of super-turbine & injection mixers, mixer data, mixer drive heads, etc. Bulletin No. 76.
279a *International Engrg.

Mixers, Dry.....Describes conical blenders (design, operation, application, capacity, sizes & specifications) & ribbon mixers (operating & construction features, specifications, etc.) Illustrated Bulletin No. 78.
279b *International Engrg.

Mixers, Portable.....Includes information on the numerous features and advantages, materials of construction, sizes and specifications, portable-permanent mountings, etc., in illustrated Bulletin 74-A.
279c *International Engrg.

Mixers, Side Entering.....Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc. in completely illustrated Catalog B-104.
121b *Mixing Equipment Co.

Mixers, Side Entering.....The Type "NU" side entrance mixer is a brand new unique mixer design. It has no cast parts and is of all welded construction, including the stuffing box. Illustrated Bulletin No. 72-A.
279d *International Engrg.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog B-103.
121c *Mixing Equipment Co.

Mixers, Top Entering.....Information on top entering propeller mixers. Includes data on selection, construction features, sizes & specifications of high & slow speed top entrance mixers, etc. Bulletin No. 73.
279e *International Engrg.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. No. B-102.
121d *Mixing Equipment Co.

Mixers, Pipe Line.....Company issues an informative booklet describing the Nettco Flomix . . . a patented and unique pipe line mixer for continuous processing applications. Fully illustrated Bulletin No. 531.
446A New England Tank & Tower.

Process Equipment.....Main categories of equipment produced include heat exchangers, stills, code vessels (ASME & ASME-API), evaporators, jacketed vessels, etc. Illustrated folder presents facilities & services.
446B Oscar Krenz, Inc.

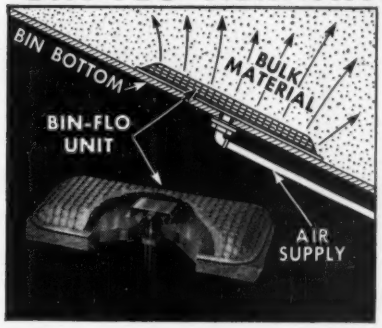
Process Systems.....Allis-Chalmers process system converts fine particles into granular product to meet consumer demand. For complete information, company offers a detailed reference, Bulletin No. 25C6177J.
319 *Allis-Chalmers Mfg. Co.

Screens, Wire.....Wire screens for vibrators are serving faithfully in daily operations in the major coal and mining centers of the world. Offers complete information on product line in Bulletins Nos. 5, 6, and 7.
BL353a *Cleveland Wire Cloth & Mfg.

*See explanation on p. 422

→ Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.

BIN-FLO AERATING UNIT

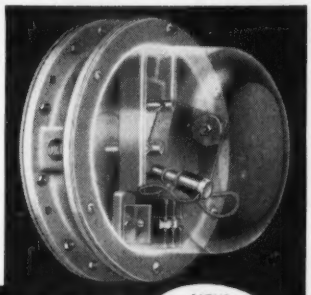


Provides Steady Flow of Dry, Finely Ground Materials which tend to bridge in storage. Uses only small amount low-pressure air.

BIN-DICATOR BIN LEVEL INDICATOR

For All Bulk Materials

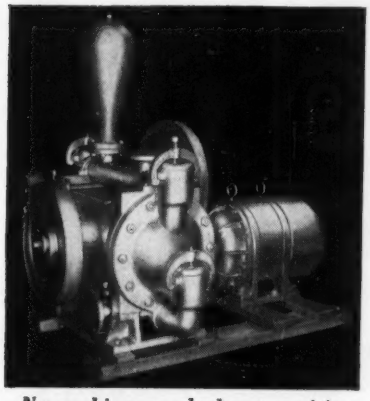
signals change in level; automatically starts and stops filling and emptying equipment.



THE BIN-DICATOR CO.
13946-D1 Kercheval • Detroit 15, Mich.

NEW DETAIL DATA BOOK FREE

This Pump Lasts Longer on Tough-to-Handle Fluids



No packings, no leakage; positive acting; requires only simple routine maintenance, built of any metal or rubber-lined; 1 to 100 g.p.m.; discharge pressures to 100 p.s.i.

Do your processes require pumping of corrosive, erosive or thick fluids, or quick-settling, heavy or crystalline materials that cause frequent pump breakdowns and replacement? Then the Shriver Diaphragm Pump can really solve your problems. Here are two typical cases:

- Pumping a heavy suspension of emery and water—"Fulfilled the needs of a tough job; simplified lay-out and installation."
- On amino acids in HCl—"By far the most economical to operate. Time and production loss due to pump servicing now negligible, whereas pumps previously used lasted only a few days at most."

There are many more such reports on the money-saving performance of Shriver Diaphragm Pumps. Write for bulletin 137.

SHRIVER Diaphragm Pump

T. SHRIVER & COMPANY, Inc.
802 HAMILTON STREET HARRISON, N. J.



FOAM STEALS SPACE

KILL IT *with a* DOW CORNING SILICONE DEFOAMER

Use the space now wasted on foam to increase your output by as much as 100%. For example:

- **production of vacuum concentrated food product increased by 60%**
- **refinery still through-put increased from 1500 to 2500 barrels per day**
- **yield of textile vat dyes increased by 100%**

And you get increased production immediately without installing expensive new equipment. All you have to do in the case of most foamers is add a few parts per million of the water dilutable Antifoam AF Emulsion or, where solvents can be tolerated, a dispersion of Antifoam A. Both of these Dow Corning silicone defoamers are physiologically harmless. Both of them **increase production • reduce processing time • eliminate the waste and fire hazard of boil-overs.**

see for yourself!
mail coupon today for
free sample

DOW CORNING SILICONES

Dow Corning Corporation
Midland, Mich., Dept. 2607

Please send me data and free sample of
☐ Dow Corning Antifoam A Compound
or ☐ Dow Corning Antifoam AF Emulsion

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE____ STATE____

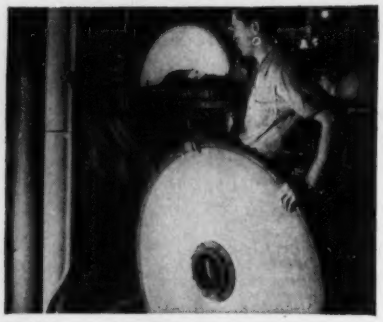


STRAINERS



SCREENS





FILTER LEAVES

Cambridge

FAST, ACCURATE PRODUCTION OF WIRE CLOTH PARTS

FOR FABRICATED PARTS call your Cambridge Engineers in the field, or call our home office. We'll help you select weaves, mesh sizes and metals to meet your needs and draw up prints for your OK . . . or, work from your prints. On small or large orders, you're assured of strict adherence to specifications by close manufacturing supervision.

A COMPLETE LINE of industrial wire cloth is available from Cambridge . . . specifications from the finest to the coarsest mesh in any metal or alloy. Uniform mesh size and accurate mesh count are assured by individual loom operation and careful inspection.

IF YOU BUY WIRE CLOTH IN BULK

You can get IMMEDIATE DELIVERY on large or small orders for the most frequently used types of cloth. If your needs are not in stock, we'll schedule our looms to get your material to you without delay.

LET US QUOTE on your next order for fabricated parts or wire cloth in bulk. Call your Cambridge Field Engineer—he's listed under "Wire Cloth" in your classified telephone book.

OR, WRITE DIRECT for FREE 80-page CATALOG and stock list giving full range of wire cloth available. Describes fabrication facilities and gives useful metallurgical data.



The Cambridge Wire Cloth Co.

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

DEPARTMENT G, CAMBRIDGE 7, MARYLAND

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

LITERATURE . . .

Thickeners, Spiral Rake.....Simple mechanical rake and settling unit for the separation of solids from liquid is subject of a new, detailed Bulletin. Valuable features, drawings, photographs, etc. No. T5-B5.
420c *Denver Equipment Co.

Pumps, Blowers, Compressors

Blowers, Rotary Positive.....Describes Miehle-Dexter Rotary-blowers . . . for all industrial products & processes—pressure or suction. Includes performance data & engineering specifications. Bulletin No. 255.
448A Miehle-Dexter Supercharger Div.

Compressors.....For heavy duty service. Offers high overall efficiency, long life with minimum maintenance; smooth quiet operation, accessibility and simplicity, compactness and ease of installation. Bulletin No. 766.
64 *Chicago Pneumatic Tool Co.

Compressors, Balanced/Opposed . . . . . Illustrated, 36 p. describes 300-10,000 hp balanced/opposed compressors—basic principles; drive; design; running gear; lubrication; capabilities; etc. Bulletin 679-B1.
22-3 *Worthington Corp.

Compressors, Carbon Piston.....Quality leader in compressor, pumps & rock drills for construction, mining, petroleum & general industry features the dependable CRX carbon piston compressor. Bulletin CRC-10.
241a *Gardner-Denver Co.

Compressors, Centrifugal.....Offers a complete line of centrifugals for gas compression and refrigeration—up to 10,000 horsepower in a single unit. Details in "Centrifugal Compressors for Industry."
292 *Carrier Corp.

Fans, Axial Flow.....Axial flow fan design offers distinct advantages worth considering for a growing variety of jobs: straight line efficiency; light weight; space savings. For details, request Bulletin No. 3533-EF.
84 *Buffalo Forge Co.

Pumps.....For automatically controlled delivery . . . pumps can handle any free-flowing liquid at discharge pressures from 300 to 15,000 psi & are available in 6 sizes—2"-6" stroke & 5-125 bhp. Data Sheet 65.
374a *Aldrich Pump Co.

Pumps.....Information on the number of rings, depth of box, type of packing . . . chemical & physical properties of fluid being pumped speed of shaft, & other usable facts, in Pump Bulletin No. S-147.
R451 *Taber Pump Co.

Pumps, Centrifugal . . . . . Impervious graphite pumps feature mechanical seal with enclosed coolant, rugged type SN armored connections, interchangeable parts, wide capacity range, etc. Catalog Section S-7250.
49a *National Carbon Co.

Pumps, Centrifugal.....In a given pump size, new standard units give at least 108 different combinations, plus maximum resistance to corrosion, erosion, cavitation. Offers complete literature on new 1750 rpm pumps.
456 *Ampco Metal.

Pumps, Centrifugal Chemical.....Worthington offers you the widest standard corrosion-resistant pump line as Karbate impervious graphite supplements Worthite. Request Bulletins Nos. W-350-B14A and W-350-B18.
20-1 *Worthington Corp.

Pumps, Centrifugal Fire.....Provides informative literature on Fairbanks-Morse fire pumps . . . the most efficient, dependable pumps in the field . . . made by the world's largest manufacturer of pumps.
71 *Fairbanks, Morse & Co.

*See explanation on p. 422

Automated

liquid handling depends on meters



SPECIFY THE INDUSTRY-PROVED **BOWSER**

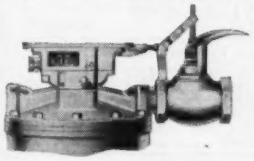
XACTO

Widest selection of models for every plant...

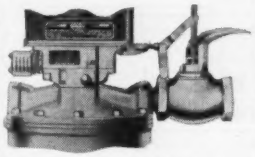
Choose from the world's leading, most widely used line. XACTO meters are easily adapted with choice of dials and controls for changing needs to speed liquid handling operations and provide accurate accounting.



Recording printer mounts on meter. Prints quantity dispensed or received.



Delivers predetermined quantities up to 10,000 gallons, then shuts off.



A repeating control for delivery of predetermined quantities. Automatic. With or less recording printer.

GET ALL THE DATA YOU NEED NOW ...WRITE...

BOWSER ESTABLISHED 1885

BOWSER, INC., FORT WAYNE, IND.

1375 E. CREIGHTON AVE.



HIGH PRESSURE VESSELS

● Whether you want conventional high-pressure units or something *special*—send us your inquiries. COLE can build you the kind of high-pressure tanks or vessels you require—any size, any shape, any metal. Our experience of a century (we were established in 1854) in the design and fabrication of metal tanks may be of help to you.

Send us your inquiries for tanks of all kinds. Write for Catalog—*Tank Talk*.

R. D. COLE

- TANKS
- TOWERS
- CYLINDERS
- VESSELS
- STANDPIPES

Manufacturing Co., Newnan, Ga.

SEE WHAT CO_2 CAN DO FOR YOU



NEW JOBS FOR CO_2

These are typical examples of CO_2 at work. Many other important CO_2 applications, covering all industry, are discussed in a booklet available from LIQUID CARBONIC — world's largest producer of CO_2.

flavor saver



Bacteria breeding air is banished when foods are packaged in an atmosphere of CO_2 gas. 50% heavier than air, CO_2 gas effectively displaces this enemy of flavor and freshness. Cost? Amazingly low. Investigate.



fabric's friend

Of all weak acids, CO_2 is a bolt's best bet. As an aid in removing caustic soda after mercerizing, boil-off and vat dying, CO_2 has no equal. It cannot burn the cloth, is the easiest acid to handle and produces a superior "hand."

sponge specialist



CO_2 is extensively used in the manufacture of both plastic sponge and foam rubber. Two of CO_2's most important applications in these fields include use as a foaming agent and as a neutralizing acid.

next case... **yours**

There's practically no end to the important jobs that CO_2—combined with LIQUID savvy—is doing. Chances are this combination can come up with some surprising answers for you, too.

FREE BOOKLET!
—mail this coupon.



THE LIQUID CARBONIC CORPORATION
3118 South Kedzie Avenue, Chicago 23, Illinois

Send me my free "Applications Unlimited" booklet.

Name _____

Company _____

Position _____

Address _____

City _____ **Zone** ____ **State** ____

HIGH VACUUM
PRODUCTION and MEASUREMENT

25 years experience in the power vacuum tube business with recognized leadership in *exhaust* processing, is available to you with Litton High Vacuum equipment.



Vapor Pumps • Traps

Vapor Pump Oils

Vacuum Measurement equipment

Model PB Pump, less valves and charcoal $268.00 f.o.b. Grass Valley, Calif.

Charcoal Baffle Assembly $53.00 f.o.b. Grass Valley, Calif.

- All Metal High Speed Oil Vapor Pump.
- Sectionalized Combinations for Charcoal Cell, Water Baffle, Valves, straight or angle Manifold connection.
- Liquid cooled, insuring uniform results regardless of environment.
- Interchangeable heaters; any voltage.
- Use with any organic medium.



MODEL L-3032 VACUUM GAUGE $75.00 f.o.b. Grass Valley, Calif.

- Philips type gauge.
- Built-in magnetic field.
- Built-in heater for outgassing after long idleness, or contaminating runs.
- Adapted to metal or glass systems.
- No tungsten clean-up.
- No filament burnout.
- Repeatable measurements.

Day in, day out dependable, rugged production or long idle and intermittent laboratory use, with consistent dependable results.

Built to take it!



MODEL 4301 VAC GAUGE AMPLIFIER AND CALIBRATION UNIT $255.00 f.o.b. Grass Valley, Calif.

A rugged production unit with all controls necessary for the outgassing, calibration and operation of the L-3032 gauge.

The demand for long shelf life and dependable snap-on operation of vacuum tubes is bringing to a close the day of mediocrity in vacuum procedure.

Let us help you in modernizing your techniques and equipment to meet these competitive needs.

Litton Engineering Laboratories
Grass Valley, California • P. O. Box 949

LITERATURE . . .

Pumps, Chemical.....Built in most used ratings . . . to 3500 gpm, heads up to 550 ft.; handle liquids in most common temperature range . . . up to 550F; in wide choice of materials; etc. Bulletin No. 52B7638.
54 *Allis-Chalmers Mfg. Co.

Pumps, Chemical.....Special alloy, steel developed for chemical pumps—Ircamet—easily handles a wide range of corrosive solutions . . . from sulfuric acid to caustic soda. For full details, request Bulletin 7095-A.
157 *Ingersoll-Rand Co.

Pumps, Constant Stroke.....For medium to high pressure service...make use of one of the numerous Aldrich constant stroke pumps—the direct flow Triplex or Multiplex pump. Details in Data Sheets 64, 64A & 64B.
374b *Aldrich Pump Co.

Pumps, Controlled Volume.....New Application Engineering Data Sheet describes the use of controlled volume pumps to proportion caustic soda to vegetable oil flow, thereby assuring proper break. Data Sheet No. B-54-I.
450A Milton Roy Co.

Pumps, Controlled Volume.....New Application Engineering Data Sheet describes an automatic control system used on natural gas pipelines to inject odorants into varying natural gas flow. Data Sheet No. E-54-7.
450B Milton Roy Co.

Pumps, Diaphragm.....A completely new & modern engineering approach to diaphragm pump design. Wheelbarrow type mounting enables one man to handle on the job. Handles slide alongside. Bulletin No. 55DP.
450C Rice Pump & Mach. Co.

Pumps, Piston-Diaphragm.....For controlled-volume pumping of fluids. Flow-charts, typical applications, description & specifications of models of various capacities & constructions, in Bulletin No. 440.
149 *Lapp Insulator Co.

Pumps, Proportioning.....Company announces a new chemical proportioning pump . . . more pump for less money. Offers information on prices, capacities, and specifications on the new Proportioneers Model No. 1105-KH.
105 *Proportioneers, Inc.

Pumps, Rotary.....Announces the availability of new Roper rotary pump catalog describing product line . . . for manufacturing marine, petroleum, process industries. Request fully illustrated Catalog No. 955.
450D Geo. D. Roper Corp.

Pumps, Rotary Hand.....Fully illustrated bulletin presents a detailed discussion of the complete line including outstanding performance features, application information and other pertinent data. Bulletin No. 320.
450E Blackmer Pump Co.

Pumps, Sand.....Soft rubber lined sand pumps lower pumping costs 30% to 70% due to simple design, lighter weight & accuracy of rubber parts which increase efficiency 1¼ to 3 times over other pumps. Bulletin P9-B8.
420e *Denver Equipment Co.

Pumps, Sealless.....Combining motor & pump in a single unit, Chempump is most significant advance in pump design in half a century. Hard-to-handle fluids can't leak or become contaminated. 16 p. Bulletin 1010.
376 *Chempump Corp.

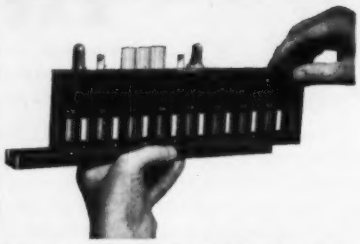
Pumps, Slurry.....Slurry pumps handle extremely thick slurries with high specific gravities. Provide long operating life with little or no maintenance. Covers features and selection data in Bulletin 181.
425 *Morris Mach. Wks.

Pumps, Sump.....Three advantages are featured in the "Buffalo" sump pump: easy installation; always in prime (since there is no suction lift); & simplified maintenance. For details, request Bulletin No. 963.
335 *Buffalo Pumps.

*See explanation on p. 422

TEST pH, CHLORINE ON THE SPOT with

TAYLOR COMPARATORS



GET ACCURATE RESULTS FAST

In 3 Easy Steps!

Place your sample right in the comparator tubes . . . add reagent to middle tube only . . . move the color standard slide across until colors match, and read result direct in pH or ppm Chlorine. That's all there is to it, and you get an immediate reading that enables you to make operating adjustments without delay.

THE COMPLETE TAYLOR LINE includes comparators for testing chlorine, bromine, phosphate, nitrate and pH; and for complete water analysis. For many determinations you can use the same comparator base with a number of interchangeable color standard slides.

COLOR STANDARDS GUARANTEED

Taylor liquid color standards carry an unlimited guarantee against fading . . no danger of mechanical inaccuracy. Each set of standards is mounted in a lightweight, durable plastic slide . . . no single standards to handle.

SEE YOUR DEALER FOR TAYLOR SETS or WRITE DIRECT for FREE HANDBOOK, "Modern pH & Chlorine Control," including theory, application and description of portable equipment.



SERVING SCIENCE AND INDUSTRY 1930 1955 FOR 25 YEARS

W. A. TAYLOR AND CO.
414 RODGERS FORGE RD. • BALTIMORE, MD

DARNELL
CASTERS & E-Z ROLL WHEELS
for the chemical industry



SAVE EQUIPMENT
SAVE FLOORS
SAVE MONEY
and TIME

for TOUGHEST
DAILY SERVICE

Featuring Darnelloprene treads - a soft, resilient Neoprene rubber compound that has superior qualities in resistance to oils, waxes, most chemicals and oxidation - these casters offer ease of movement, quietness and protection for floors.

DARNELL CASTERS
& E-Z ROLL WHEELS
Always
SWIVEL and ROLL

Free Manual

DARNELL CORPORATION, LTD.
DOWNEY (LOS ANGELES COUNTY) CALIFORNIA
60 WALKER STREET, NEW YORK 13, NEW YORK
36 NORTH CLINTON STREET, CHICAGO 6, ILLINOIS

LITERATURE . . .

Services, Processes, Misc.

Accident Prevention Signs . . . . . Brady self-sticking, accident prevention signs on handy "blue streak" dispenser cards . . . let you apply vital safety warnings right at the point-of-hazard. Data in illustrated Bulletin 145-C.
451A W. H. Brady Co.

Area Resources.....No other area so well situated in relation to plant sites & markets (Utah-Idaho-Wyo.-Colo.) has such a rich store of raw materials needed by industry. "A Treasure Chest in the Growing West".
451B Utah Power & Light Co.

Coordinated Precision Technology..... The highly advanced technological products designed & manufactured by 18 producing companies of GPE Corp. serve more than a dozen major industries. Request Brochure.
162-3 *General Precision Equip. Corp.

Engineering Services.....Help protect your equipment investment—application engineering, analytical engineering, product development, field-service engineering maintenance service, etc. Brochure GED-2244.
37-40a *General Elec. Co.

Plant Sites.....For a detailed description of the many industry advantages in the American Gas and Elec. service area (Mich.-Ind.-Ohio-Ky.-W. V.-Va.-Tenn.), request brochure, "A 7-State-Plant-Site-Trip—in 5 Minutes."
451C American Gas & Elec. Co.

Plants, Chemical.....Expands plant with a minimum of interference to operations—features outstanding record of maintaining operating efficiency during construction period. Request new chemical Brochure 101.
158 *Kaiser Engrs.

Protection, Structural Steel.....Announces the availability upon request of a new publication, "The Protection of Structural Steel (Current Good Painting Practice for Steel Structures in the United States)." 8 p.
451D Mellon Institute.

Safety Practices . . . . . "Five-Minute Safety Talks for Foremen" covers general industrial practices . . . fire protection, material handling, control of machine hazards, etc. Request illustrated Books Nos. 1 & 2.
451E National Safety Council.

Spray-Stops . . . . . Milsheff Spray-Stops protect personnel & equipment by deflecting leakage at valves & joints . . . spot pipeline leaks instantly by changing color when hit by chemicals. Illustrated Booklet.
451F Milsheff Corp.

Testing, Batch & Continuous.....Use Denver testing laboratory facilities for complete batch or pilot tests. Ample test facilities for investigations on crushing, grinding, mixing, etc. Bulletin T4-B15.
420d *Denver Equipment Co.

Water Conditioning Equipment.....For boiler feed, process, & other industrial needs. Describes mono-bed demineralizers; 4-column demineralizers; degasifiers; water softeners; water filters; etc. Illustrated, 4 p.
451G Pennfield Mfg. Co.

Water Conditioning Equipment.....New bulletin presents a concise discussion of the basic types of equipment available for treatment and includes photographs of typical installations. Request Brochure WC-117.
451H Graver Water Conditioning.

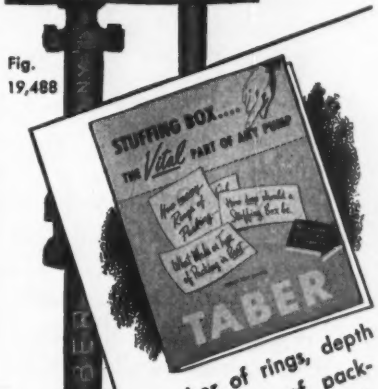
Water Service.....“Cracking & Embrittlement” outlines water system trouble spots & factors that can produce breakage & failure in components of heaters, boilers, condensers, process equipment & interconnecting piping.
451I Hall Labs.

*See explanation on p. 422

PUMP STUFFING BOXES

INFORMATION suggesting solution of common stuffing box difficulties; available in newly revised BULLETIN S-147

Fig. 19,488



Number of rings, depth of box, type of packing . . . chemical and physical properties of the fluid being pumped, speed of shaft and other pertinent usable facts are in this Bulletin.

WRITE on business stationery for your copy of Bulletin S-147.
TABER PUMP CO. (Est. 1859)
294 ELM ST. • BUFFALO 3, N. Y.

Fig. 6041



TABER

Index to Advertisers

Month after month you'll find industry's most progressive firms among our ad pages. Use this index to keep in touch with what they're offering that'll help you in your job.

Adams Co., R. P. 18
Admiral Tool & Mfg. Co., Inc. 396
Aerofin Corp. 426
Air Preheater Corp. 283
Air Reduction Co.,
Pure Carbonic Div. 76
Alco Products, Inc. 247
Aldrich Pump Co. 374
Allied Chemical & Dye Corp.
Baker-Adamson Products
General Chemical Div. 115
General Chemical Div. 109
Nitrogen Div. 151
Semet-Solvay Div. 269
Solvay Process Div. 145
Allis-Chalmers Mfg. Co.
General Machinery Div. ..54, 98, 319, 378
Tractor Div. 380
Alloy Fabricators Div. of Continental Copper & Steel Industries, Inc. 441
Alloy Steel Products Co. 93
Alpha Plastics Inc. 431
Aluminum Co. of America ..82, 147
Alvey Conveyor Mfg. Co. 356
Amercoat Corp. 261, 311
American Brass Co., The (Anaconda) 77
ACF Industries, Inc.
Valve Div. 159
American Chain & Cable
Helicoid Gage Div. 358
American Cyanamid Co. 14-15
American Cystoscope Makers .. 353
American Hard Rubber Co. 231
American Machine & Metals, Inc. Niagara Filter Div. 324
American Optical Co. 310
American Water Softener Co. .. 458
American Wheelabrator & Equipment Corp. 308
Ampco Metals, Inc. 456
Anaconda Wire & Cable Co. 287
Annin Co. 299
Appleton Electric Co. 152
Armco Steel Corp. 361
Avondale Marine Ways, Inc.
Avoncraft Div. 377

Babbitt Steam Specialty Co. 439
Babcock & Wilcox Co., Tubular Div. 138-139
Bailey Meter Co. 83
Baker & Adamson Products
General Chemical Div., Allied Chemical & Dye Corp. 115
Bell & Gossett Co. 383
Bemis Bros. Bag Co. 454
Bethlehem Steel Co.
Shipbuilding Div. 318
Bin-Dicator Co. 447
Bird Machine Co. 6, 11
Black, Sivalls & Bryson, Inc.
Safety Head Div. 337
Blaw-Knox Co.
Buflovak Div. 46
Blickman, Inc., S. 332
Boardman Co., The 438
Bowser, Inc. 449
Bridgeport Brass Co. 53
Brighton Copper Works, Inc. .. 346
Bristol Co. 262-263
Brown Co. 413
Brown & Root, Inc. 117
Buffalo Forge Co. 84
Buffalo Meter Co. 345
Buffalo Pumps, Inc. 335
Byron Jackson Co. 381

Cambridge Wire Cloth Co., The 448
Camco Products, Inc. 357
Carboline Co. 444
Carborundum Co. 59
Carpenter Steel Co.
Alloy Tube Div. 390
Carrier Corp. 292
Cash-Standard 291
Catalytic Construction Co. 137
Celanese Corp. of America 168
Chapman Valve Mfg. Co., The. 58
Chase Brass & Copper Co. 169
Chemical Construction Corp. A Unit of American Cyanamid 55
Chemical & Power Products, Inc. 441
Chempump Corp. 376
Chemsteel Construction Co., Inc. 397
Chesterton Co., A. W. 436
Chicago Bridge Iron Co. 129
Chicago Pneumatic Tool Co. .. 64
Childers Mfg. Co. 150
Cleveland Wire Cloth & Mfg. Co. 353
Cole Mfg. Co., R. D. 449
Combustion Engineering, Inc. Raymond Div. 326
Consolidated Chemical Industries, Inc. 303
Continental Can Co. 19
Continental Copper & Steel Industries, Inc.
Alloy Fabricators Div. 441
Cooper Alloy Corp. 78
Corning Glass Works 254-255
Crane Co. 277, 325
Crane Packing Co. 352
Crouse Hinds Co. 171
Crucible Steel Co. of America Stainless Steel Div. 388

Darling Valve & Mfg. Co. 445
Darnell Corp., Ltd. 451
Davenport Machine & Foundry Co. 433
Davis Engineering Co. 457
Davis Regulator Co. 394D
Day Co., J. H. 354
DeLaval Separator Co., The ... 131
DeLaval Steam Turbine Co. 314
Denver Equipment Co. 420
Diehl Mfg. Co. 253
Dings Electronics, Inc. 423
Dorr-Oliver Inc. 106-107, 348
Dow Corning Corp. 447
Dowell Inc. A Subsidiarly of The Dow Chemical Co. 316
Downingtown Iron Works 419
Dracco Corp. 123
Drever Co. 313
duPont de Nemours & Co., Inc. Polychemicals Dept. 133
Durabla Mfg. Co. 347
Duraloy Co. 336
Duriron Co., Inc., The 259

Eimco Corp. 365
Electric Auto-Lite Co. 355
Elliott Co. 85
Enjay Co., Inc. 271
Exact Weight Scale Co., The .. 355

Fairbanks, Morse & Co. 71
Falk Corp. 317
Farris Engineering Corp. 50-51
Fenwal, Inc. 66

Sales Representatives

Atlanta 3.....W. D. Lanier, 1321 Rhodes-Haverty Bldg., Walnut 5778-2823
Boston 16.....W. D. Boyd, 350 Park Square Bldg., Hubbard 2-7160
Chicago 11.....D. Gridley, J. M. Rodger, Jr., 520 N. Michigan Ave., Mohawk 4-5800
Cleveland 15.....L. J. Biel, 1510 Hanna Bldg., Superior 1-7000
Dallas 1.....James Cash, First National Bank Bldg., Prospect 7-5064
Detroit 26.....L. J. Biel, 856 Penobscot Bldg., Woodward 2-1793
Los Angeles 17.....W. C. Woolston, 1111 Wilshire Blvd., Madison 6-4323
New York 36.....R. G. Frederick, J. E. Tuohig, 330 West 42 St., LOngacre 4-3000
Philadelphia 3..E. M. Schellenger, Architects Bldg., 17th & Sansom Sts., Rittenhouse 6-0670
Pittsburgh 22.....G. S. Ryan, 919 Oliver Bldg., ATlantic 1-4707
San Francisco 4.....T. E. Wyckoff, 69 Post St., Douglas 2-4600
St. Louis 8.....J. M. Rodger, Jr., 3615 Olive St., Continental Bldg., Lucas 4867

Filtration Engineers, Inc. . . 330, 331
Firestone Tire & Rubber Co.
Firestone Plastics Div. 364
Fisher Governor Co. 239
Fischbein Co., Dave 433
Foster Engineering Co. 433
Flakice Corp. 397
Foram Corp. 394D
Foster Wheeler Corp. 127
Foxboro Co., The 57
Frantz Co., Inc., S. G. 439
Fruehauf Trailer Co. 392
Fuller Co. 384

Gardner-Denver Co. 241
Garlock Packing Co. 442
Gas Atmosphere, Inc. 338
General American Transp. Corp.
Tank Car Div. 245
General Chemical Div.
Allied Chemical & Dye Corp. 109
General Electric Co. . 37-40, 167, 233
General Mills, Inc. 391
General Precision Equipment
Corp. 162-163
Gifford-Wood Co. 351
Girdler Co., The . . . 2nd Cover, 343
Glitsch & Sons, Inc., Fritz W. . . . 432
Glycerine Producers' Assoc. 379
Goodrich Chemical Co. B. F.
Geon Division 9
Grace & Co., W. R.
Davison Chemical Corp. Div. 91
Graver Tank & Mfg. Co., Inc. . . 304
Great Lakes Carbon Corp.
Dicalite Div. 251
Greer Co., J. W. 443
Grinnell Co., Inc. 8
Griscom Russell Co. 164
Gutehoffnungshutte
(Foram Corp.) 394D

Hardinge Co., Inc. 414
Harshaw Chemical Co., The . . 101
Haynes Stellite Co., Div. of Union
Carbide & Carbon Corp. 257
Hercules Powder Co. 96
Heyden Chemical Corp. 143
Hills-McCanna Co. 453
Hooker Electrochemical Co. . . . 369

Illinois Testing Laboratories, Inc. 349
Illinois Water Treatment Co. . . . 396
Independent Engineering Co. . . 439
Infilco, Inc. 170
Ingersoll-Rand Co. 157
International Engineering Co. . . 279
International Nickel Co., Inc. 72, 80
International Paper Co. 387

→ Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.



HILLS-McCANNA DIAPHRAGM VALVES

for trouble-free valving of corrosive fluids . . .

Ten valves ceiling mounted, controlling the flow of thousands of gallons of valuable fluids daily, could be a real maintenance problem, but the valves shown in the photo don't present this problem . . . and here's why:

Repairs are rare . . . normally only occasional diaphragm replacement is necessary with the Hills-McCanna diaphragm valve. Even that is easy — the entire bonnet assembly is removed with four nuts, leaving the body in line. Since all working parts are isolated from the flow, no fluid ever gets to the bonnet . . . making packing *and* packing worries unnecessary.

Hills-McCanna Diaphragm Valves are available in a choice of body materials of any machinable alloy, or with linings of lead, glass, rubber, plastic, etc. Fifteen diaphragm materials including rubber, Teflon and synthetics are available and a choice of lever, handwheel or remote operators make Hills-McCanna headquarters for valving hundreds of corrosive fluids. Add your valve needs to the list if they are in the range of ⅜" through 14", pressures to 150 psi and temperature to 350° F. Write HILLS-McCANNA CO., 2341 Nelson St., Chicago 18, Ill., for details.

HILLS-McCANNA

saunders patent diaphragm valves

Also Manufacturers of:
PROPORTIONING PUMPS
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS



Bemis Multiwalls made with RUF-GRIP kraft handle easily . . . and stack easily . . . and stay stacked. Consequently, they ship and store better. Get the details from your Bemis Man.

* TRADE-MARK

Also in the Bemis Family, Serving the Chemical Industry . . .

Waterproof (Laminated) Bags

Bemis

General Offices—St. Louis 2, Mo.
Sales Offices in Principal Cities

ADVERTISERS . . .

Jeliff Mfg. Co., C. O. 351
Jenkins Bros. 305
Johns-Manville Corp.
Celite Filter Aids Div. 141
Insulation Div. 265
Packings Div. 370
Joy Mfg. Co. 7

Kaiser Aluminum & Chemical Corp. 79
Kaiser Engineers, Div. Henry J. Kaiser Co. 158
Kellogg Co., The M. W. Kel-F Div. 249
Kerrigan Iron Works, Inc. 440
Kidde & Co., Inc., Walter 328
Kinney Mfg. Co. 165
Koppers Co., Inc.
Engrg. & Construction Div. . . 366
Precipitator Dept. 67

LaBour Co., Inc., The 275
Ladish Co.
Tri Clover Div. 301
Lapp Insulator Co.
Porcelain Process Div 307
Pulsafeeder Div. 149
Leeds & Northrup Co. 92
Leslie Co. 293
Link Belt Co. 13, 63
Liquid Carbonic Corp. 449
Liquidometer Corp., The 395
Lithium Corp. 68
Litton Engineering Laboratories 450
Lukens Steel Co. 373

Magnetic Amplifiers, Inc. 415
Manheim Mfg. & Belting Co. . . 81
Manning, Maxwell & Moore, Inc. 48
Master Electric Co., The . . . . . Third Cover
McCloskey Co. of Pittsburgh . . 349
McGraw-Hill Book Co. 355
McLouth Steel Corp. 88
McNally-Pittsburg Mfg. Corp. . . 434
Merrick Scale Mfg. Co. 397
Metalweld, Inc. 397
Midvale Co. 52
Midwest Piping & Supply Co. . . 309
Minneapolis-Honeywell Regulator Industrial Div. 94-95
Mixing Equipment Co. Inc. 121
Morris Machine Works 425

Nagel Pumps, Inc. 431
Nash Engineering Co. 86
National Aluminate Corp. 342
National Carbon Co., Div. of Union Carbide & Carbon Corp. 32-33, 49
National Filter Media Corp. . . . 446
National Lead Co. 125
National Petro Chemical Corp. . 289
National Research Corp. 394C
Neptune Meter Co. 417

Neville Chemical Co. 375
Newark Wire Cloth Co. 427
Niagara Alkali Co. 17
Niagara Blower Co. 455
Nitrogen Div., Allied Chemical & Dye Corp. 151
North American Car Corp. 87
Norton Co. 315

Ohio Injector Co., The..... 285
Olin Mathieson Chemical Corp. Industrial Chemicals Div. ... 111
O. P. W. Corp. 25
Orr & Sembower, Inc. 97
Owens-Corning Fibreglas Corp. 362

Pangborn Corp. 334
Partlow Corp., The..... 437
Patterson Kelley Co., Inc. 28
Peabody Engineering Corp. 416
Penn Metal Co. 386
Perkin-Elmer Corp., The..... 267
Pfaudler Co. .....Back Cover
Phelps Dodge Copper Products Corp. 242-243
Phillips Chemical Co. 43
Pittsburgh Lectrodryer Corp. .. 47
Platecoil Div., Tranter Mfg., Inc. 44
Powell Co., The Wm. 45
Powers Regulator Co. 297
Pressed Steel Co. 441
Process Filters, Inc. 341
Proctor & Schwartz, Inc. 418
Proportioneers Div. of B. I. F. Industries, Inc. 105
Pure Carbonic Co. Div., Air Reduction Co. 76
Pyrene-C-O-Two 306

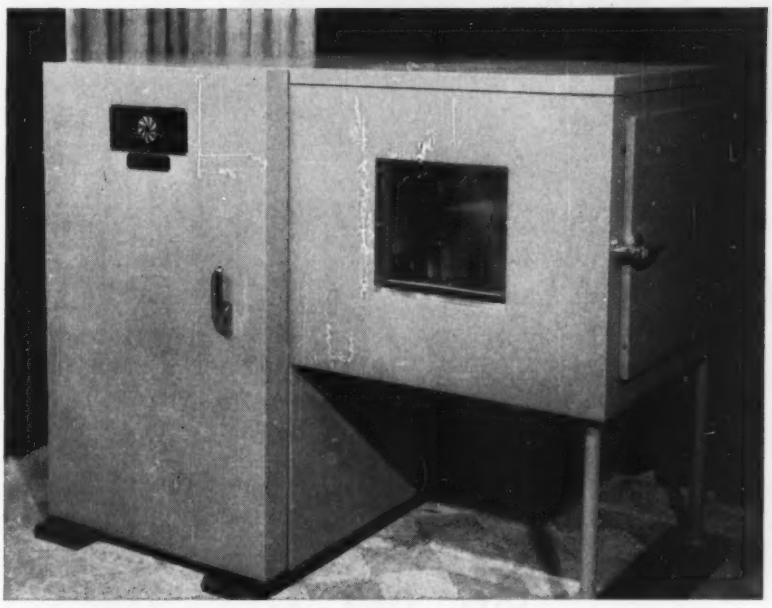
Raymond Div., Combustion Engineering, Inc. 326
Read Standard Corp. Blower-Stoker Div. 344
Reliance Electric & Engrg. Co. . 34
Republic Steel Corp. 30-31
Revere Copper & Brass, Inc. .. 295
Reynolds Metals Co. 26-27
Richardson Scale Co. 272
Robertshaw-Fulton Controls Co. Fielden Instrument Div. 333
Rockwell Mfg. Co. 69-70, 393
Roots-Connersville Blower Div. of Dresser Industries, Inc. ... 429
Ryerson & Sons, Inc., J. T. ... 172

Sanborn Co. 360
Saran Lined Pipe Co. 90

Saving your money?

Maybe you shouldn't. For a small investment in editorial reprints may pay off handsomely. Run through our Checklist to see if you can put any of these special reports to good use now.

NEW NIAGARA



AIR CONDITIONED TEST CABINET

USES—to determine effects of controlled temperature and humidity conditions on test subjects of all kinds—to test processes—to find optimum conditions.

RANGE—With water and electric power services only, the range is from freezing temperature up to 150°F (dry bulb). With refrigeration, and using Niagara No-Frost Liquid to prevent freezing of sprays, you achieve dew point temperatures as low as minus 30° F. Control of relative humidity from 5% to 95% is obtained at all temperatures in this range. Air capacity is 200, 400 or 600 c.f.m.

METHOD—Air is saturated in the air-conditioning unit at the required dew point temperature and reheated to the desired dry bulb temperature. This is the method of the Niagara Type A Air Conditioner which has been proven for the most exacting duty over twenty-five years.

CONTROL—The dew point thermostat is located in the air stream, the dry bulb thermostat in the test cabinet. No moisture sensitive instruments are needed. Recorders may be used to obtain a complete record of conditions.

TEST CABINET—(inside) dimensions are 30" x 28" x 24" with access clear opening 26" x 22". Insulation is the equivalent of 4" cork.

AIR CONDITIONING UNIT is enclosed in an insulated cabinet adjoining the test cabinet. A door the full size of the cabinet wall gives complete access.

Write for Complete Information. Address Dept. C.E.

NIAGARA BLOWER COMPANY

405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada



WOW!

You pay no premium for Ampco* Centrifugal Pumps — the pumps that resist corrosion, erosion, and are easily adapted to changing demand

First of all, you can get an Ampco Centrifugal Pump in any alloy you want, with high efficiencies, to give you the maximum resistance to corrosion and erosion your process requires.

You save on power too, because Ampco Pump efficiencies remain high under the most adverse conditions. There are no unstable curves in the Ampco Pump family.

And, if you're faced with changing demands, and you have to run your pump "off rating," an Ampco Pump will fulfill your conditions. You get a pump that saves you money — money on shaft breakage, bearing failures, seal breakage, fretting, etc.

Here's why! Ampco Centrifugal Pumps give you numerous combinations. You can get the exact shaft you need, including standard, heavy, extra-rigid and two-piece designs.

You can select the bearings you want — sealed, replenishable grease, or oil-lubricated, single and double widths.

You can choose your shaft seals — inside or or outside mechanical seals; internal, external, or flushing-packed stuffing boxes.

You can pick the pedestal height and type of impeller you want.

And here's another saving — you don't have to buy a new pump when your conditions change. Thanks to the versatility of Ampco Centrifugal Pump design, you can make modifications in the field — quickly and inexpensively.

It pays to use Ampco Centrifugal Pumps in your tough spots. Speeds — 1750 and 3500 rpm. Capacities to 600 gpm. Heads to 300 ft. Write for latest literature.

*Reg. U. S. Pat. Off.

AMPCO METAL, INC.
Dept. CE-7
Milwaukee 46, Wisconsin
West Coast Plant • Burbank, California

P-15

ADVERTISERS . . .

Schneible Co., Claude B. 349
Schutte & Koerting Co. 65
Sealol Corp. 350
Servel, Inc. 389
Selas Corp. of America..... 160
Servo Corp. of America..... 421
Sharples Corp., The..... 135
Shell Chemical Co. 119
Shippers Car Line Corp..... 73
Shriver & Co., Inc. T..... 447
Sigamotor Inc..... 395
Sly Mfg. Co., The W. W..... 430
Smith Corp. A. O.
Process Equipment Div.....60-61
Smith Co., S. Morgan..... 339
Solvay Process Div., Allied
Chemical & Dye Corp..... 145
Sparkler Mfg. Co..... 385
Sperry Co., D. R.....394A
Spraying Systems Co..... 396
Sprout-Waldron & Co., Inc..... 367
Standard Conveyor Co..... 428
Standard Oil Co. (Indiana).... 281
Standard Steel Corp..... 368
Stanley Co., Inc. W. W..... 395
Star-Kimble 351
Stearns Magnetic, Inc..... 237
Stokes Machine Co. F. J..... 359
Strahman Valves, Inc..... 353
Sturtevant Mill Co..... 166
Sun Shipbuilding & Dry Dock
Co. 100
Sutton, Steele & Steele, Inc..... 431
Swenson Evaporator Div.
Whiting Corp..... 273

Taber Pump Co..... 451
Tank Car Div., General Ameri-
can Transportation Corp..... 245
Taylor & Co., W. A..... 450
Taylor Instrument Cos.....16, 372
Terry Steam Turbine Co..... 42
Texas Gulf Sulphur Co..... 153
Toledo Scale Co..... 435
Tranter Mfg. Inc., Platecoil Div 44
Traylor Engineering Mfg. Co... 29
Trent Tube Co., Crucible Steel
Co. of America..... 371
Tri-Clover Div., Ladish Co..... 301

Uehling Instrument Co..... 397
United Chromium Div., Metal &
Thermit Corp..... 382
U. S. Electrical Motors, Inc..... 363
U. S. Gasket Co.....329, 340

Keeping too busy?

You'll find our streamlined Reader Service section right up your alley. It's designed for busy engineers who want to find things fast, get more information fast. RS is easy to use, and you can bank on it.

U. S. Industrial Chemicals Co. 35-36
U. S. Rubber Co.
Mechanical Goods Div..... 312
U. S. Steel Corp.
Alloy Div.....154-155
U. S. Stoneware Co., The..... 102

Vogt Machine Co., Henry..... 56

Wagner Electric Corp..... 62
Walworth Co., The..... 161
Washington Aluminum 395
Weckesser Co..... 397
Welding Fittings Corp..... 10
Welsbach Corp..... 394
West End Chemical Co..... 12
Western Supply Co..... 89
Westinghouse Electric Corp...74-75
West Point Mfg. Co., Wellington Sears Subsidiary..... 156
Wilfley & Sons, A. R..... 235
Williams Patent Crusher & Pulverizer Co..... 99
Worthington Corp.
Air Conditioner & Refrigeration Div..... 24
Centrifugal Pump Div.....20-21
Compressor Div.....22-23

Yarnall-Waring Co..... 41

SEARCHLIGHT SECTION
PROFESSIONAL SERVICES 398
CLASSIFIED ADVERTISING
F. J. Eberle, Ass't. Mgr.

EMPLOYMENT OPPORTUNITIES 399-401
Arabian American Oil Co..... 400
Courtaulds (Alabama) Inc..... 400
Dow Corning Corp..... 401
Drake Personnel Inc..... 399
Fisher Scientific Co..... 400
Linde Air Products Co..... 400
National Lead Co., of Ohio..... 400
O'Shea Employment System..... 399
Pillsbury Mills, Inc..... 401
Selective Placement Employment Agy. 399
Standard Oil Co..... 401

SPECIAL SERVICES 402

EQUIPMENT
(Used or Surplus New)
For Sale 402-410

WANTED
Equipment 402
Miscellaneous 402

ADVERTISERS INDEX
Aaron Equipment Co..... 410
American Air Compressor Corp... 404
Anchor Supply Co..... 408
Barcan Co., Irving..... 402
Best Equipment Co..... 410
Brill Equipment Co.....405, 408
Chemical Service Corp..... 402
Consolidated Products Co., Inc.... 410
Equipment Clearing House Inc.... 408
First Machinery Corp..... 407
Foster Co., L. B..... 406
Gelb & Son Inc., R..... 409
General Traders Inc..... 410
Heat & Power Co., Inc..... 407
Kehoe Machinery Corp..... 402
Lawler Co. 404
Lilly & Co., Eli..... 408
Loeb & Equipment Supply Co..... 402
Loeb & Son, H..... 404
Luria Steel & Trading Corp..... 406
Machinery & Equipment Corp..402, 406
Meyer & Son Inc., Wm. W..... 408
Moffitt Sales Co..... 406
Newman Tallow & Soap Machy. Co. 404
O'Neill, A. J..... 402
Perry Equipment Corp.....403, 410
Process Plants Service Inc..... 406
Stanhope Inc., R. C..... 407
Stein Equipment Co..... 408
Truland Chemical & Eng. Co..... 402
Union Standard Equipment Co.... 404
Weinstein Co. 402



Check with Paracoil

here's why...

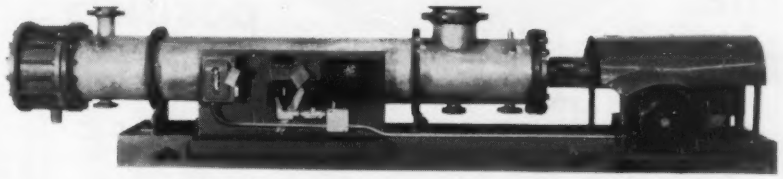
EXPERIENCE... 40 years of design and fabrication for the nation's leading concerns, assures you of the correct engineering solution to your problem by men thoroughly familiar with your requirements.

QUALITY... durably built, and conservatively rated — with long operating life at top output.

ECONOMY... Mass production of standard models — and accumulated know-how applied to your specific designs keep our prices competitive.

DELIVERY... Heavy inventory stock and efficient factory techniques permit fast delivery.

here's an example...



Automatic Self-Cleaning Wax Dehydrator

This Paracoil heat exchanger is used to reduce the water content of tallow. The tallow mixture is pumped thru the heater shell in baffled flow across the tubes. The movable baffles travel back and forth along the tubes, keeping them clean of accumulated tallow. The result is increased plant production due to higher temperatures and the elimination of outage time necessitated with the cleaning of batch process drying kettles.

DAVIS ENGINEERING CORPORATION
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y. • 1064 EAST GRAND ST., ELIZABETH 4, NEW JERSEY



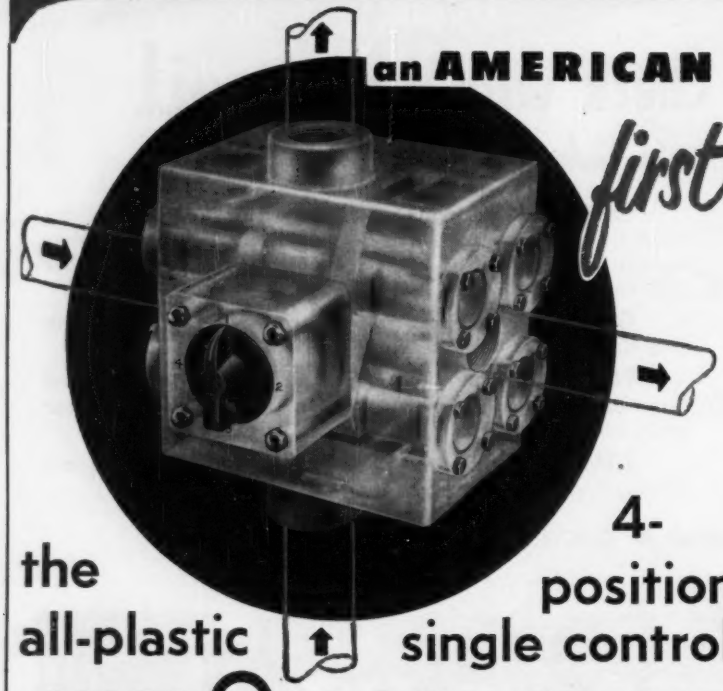
Since 1915 . . . Paracoil's skill to do comes of doing . . . Since 1915

ON WATER CONDITIONING CONSULT AMERICAN . . . first

advanced engineering is the important factor in

AMERICAN water conditioning service

an AMERICAN first!



the all-plastic 4-position single control

CYCLOFLOW VALVE

for controlling ion exchange cycles

Completely impervious to acids and alkalies, it assures against corrosion. Leakproof operation is insured by vented and drained isolation chamber, preventing contamination of effluent. Requiring a minimum of torque for operation, the CYCLOFLOW VALVE is adaptable for automatic, semi-automatic or manual operation with no alteration or additional field adjustment of components. Positive valve action obtained by simple fingertip control. Design eliminates spring loading and large unbalanced areas and flat surfaces which cause leakage.

Write for copy of Bulletin 600

SERVICE SINCE 1902 — TO THE INDUSTRY

AMERICAN Water Softener COMPANY

INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEAERATORS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEALKALIZERS • AERATORS & DECARBONIZERS

HYDROGEN-SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

Editorial Reprints . . .

• Processes and Costs

1 Chemical Engineering's Flowsheets—150 process flowsheets ($2).
2 Cost Estimation I—38 articles, 128 pp. of data ($1.75).
3 Cost Estimation II—12 articles, 48pp. Apr. '52-Feb. '53 ($1).
48 Cost Estimation III—17 articles, 80 pp. to May '54 ($1.25).
52 Heat Exchanger Design—(75¢).
56 Cost Index—Subject index to 351 cost estimating articles **(50¢).**
65 Cost Index—Supplement (35¢).

• Feature Reports

4 Fluid Flow—15 articles ($1).
21 Pumps—How to select chemical pumps (50¢).
22 Process Instrumentation — 48-p. report and 16-p. chart ($1).
25 Size Reduction—Covers crushing, grinding and pulverizing (50¢).
26 Petrochemical Processes—Data on 23 major processes (50¢).
28 Solids Feeders—How to lick feeding difficulties (50¢).
33 Fluidized Solids—Timely survey of fluidization know-how (50¢).
34 Heat Technology — Heat production, transport and transfer ($1).
36 Strain Gages—How to use (50¢).
37 Entrainment Separation — Equipment and performance (50¢).
40 Process Piping—Roundup of piping, valves, fittings (75¢).
46 Conveyors & Elevators—Solutions to bulk moving problems (50¢).
47 Mixing—Understand this universal operation, 48pp. (75¢).
50 Lubrication—Of chemical equipment, for plant engineers (50¢).
53 Engineering With Models—Both scale and test models (50¢).
54 Binary Distillation—Theory, equipment (75¢).
55 Ion Exchange—A chronical of remarkable advances (75¢).
59 Photochemical Engineering—Uses, processes, reactors (75¢).
62 Solids-Liquid Separation — Know-how in 1955 ($1).
63 Solids-Gas Contacting—Integrated background (50¢).
64 Moving-Bed Processes — Theory and applications (75¢).

• Materials of Construction

29 Protective Coatings—How to select, use against corrosion ($1).
35 Industrial Plastics — How and where to use (50¢).
38 Stainless Steels — Properties and corrosion data (75¢).
43 Hasteloys B.C.D.—Combined Corrosion Forum reprint (75¢).
58 16th Biennial Report—64 p. review of Corrosion resistance ($1).

• CE Refresher Series

42 Thermodynamics Principles (50¢).
45 Compression & Expansion—(50¢).
49 Chemical Equilibrium—(50¢).
57 Homogeneous Kinetics—(50¢).
61 Catalytic Kinetics—(50¢).

Order Now:

Use your reader service postcard for the fastest delivery. Pay when billed.

Attention NON-SUBSCRIBERS:

Why be just another name on a magazine circulation list . . . when you can have your own copy of CE for less than a PENNY A DAY?

JUST A PENNY A DAY could have brought you the personal use of all the information in this issue. Just think . . . with your own copy of CHEMICAL ENGINEERING, there is no waiting for each issue to reach you and there is no need to hurry it along. You can clip articles for your files . . . the entire issue is yours, as personal as your newspaper.

Why wait? Use the handy coupon below to order your personal subscription to CHEMICAL ENGINEERING today!

No need to send any money now. We'll bill you later.

TO SUBSCRIBE:

1. How many years? →
2. About your company →
3. HOME mailing address if you prefer →

BE SURE TO FILL OUT OTHER SIDE OF CARD BEFORE MAILING

KEY NUMBERS Circle for more information about

- **ADS**
- **EQUIPMENT**
- **PRODUCTS**
- **SERVICES**
- **LITERATURE**

and

- **FLASHBACK ITEMS** (See page 421)

TO ORDER REPRINTS
Indicate quantities for each (See page 458)

FOR CHANGE OF ADDRESS (Give both old and new address)
Old Address →
New Address →

New Subscription Form:
Domestic Rates only. For all others, see p. 5 1 Year $3☐; 2 years $4☐; 3 Years $5☐
Product or service No. employees approx.

Street: City: State:

2	49g	85d	121h	162-3	273a	287	333b	367a	420e	434F	435K	429e	435A	443D			
6	50-1a	85e	123	164	273b	288A	333c	367b	420d	434G	435L	429f	435B	444			
8	50-1b	85f	125	165	273c	288B	334	367c	420e	434H	436	430A	435C	444A			
9	50-1c	85g	127	166	273d	288C	335	367d	430f	434I	436A	429B	435D	444B			
10	52	85h	129	167	274A	288D	336	368	431	434J	436B	430C	435E	445			
11a	53	85i	131	168	275	288E	337	369	432A	434K	436C	429D	435F	446			
11b	54	85j	133a	169	276A	290A	338	370	432B	434L	436D	429E	435G	446A			
11c	55	85k	133b	170	277	290B	339	371	432C	434M	436E	429F	435H	446B			
12	56	85l	133c	171	278A	290C	340	373a	432D	434N	436F	429G	435I	TL447			
13	57	87	133d	231a	278B	290D	341	373b	432E	434O	436G	429H	435J	BL447			
18	58	88	135	231b	278C	290E	343	374a	432F	434P	436H	429I	435K	R447			
19	59	89	137	231c	279a	292	344	374b	432G	434Q	436I	429J	436	448			
20-1	60-1a	90	140A	231d	279b	295	345	375	432H	434R	436J	430	436A	448A			
23-3	60-1b	91	141	233	279c	301	346	376	432I	434S	436K	430A	436B	TL449			
24	60-1c	92	143	235	279d	303	347	377	432J	434T	437	430B	436C	BL449			
25	60-1d	93	144A	237	279e	304	TL349	378	432K	434U	437A	430C	436D	R449			
29a	62	94-5	144B	239	279f	306	BL349	379	432L	434V	437B	430D	437	L450			
29b	63	96a	145a	241a	279g	307	R349	380	432M	434W	437C	430E	437A	R450			
29c	64	96b	145b	241b	279h	309	350	382a	432N	434X	427D	430F	437B	450A			
29d	65	96c	146A	241c	279i	311	TL351	382b	432O	434Y	427E	430G	437C	450B			
29e	66a	96d	146B	241d	279j	313	BL351	383	432P	434Z	427F	430H	438	450C			
29f	66b	97	147	241e	279k	314	R351	384	432Q	434AA	427G	L431	438A	450D			
29g	67	98	148A	241f	280A	315	353	387	432R	434BB	427H	TR431	438B	450E			
33-3	68	99a	148B	241g	280B	316	TL353	393	432S	434CC	427I	BR431	L439	L451			
34	69-70	99b	148C	241h	280C	317	BL353a	TL395	432T	434DD	427J	432	TR439	R451			
35-6a	71	99c	148D	242-3	280D	319	BL353b	BL395	423	434EE	428	432A	BR439	451A			
35-6b	73	99d	148E	247	281	324	R353	TR395	423A	434FF	428A	432B	440	451B			
35-6c	74-5	99e	148F	249	282A	325	354	BR395	423B	434GG	428B	432C	440A	451C			
37-40a	76	99f	148G	251	282B	326	TR355	TR396	423C	434HH	428C	432D	440B	451D			
37-40b	77	99g	148H	253	282C	328	BR355	BR396	423D	434II	428D	432E	440C	451E			
41	78a	101	148I	254-5a	282D	329	356	L397	423E	434JJ	428E	TL433	440D	451F			
42	78b	102	148J	254-5b	282E	330	R357a	413	423F	434KK	428F	BL433a	440E	451G			
43	78c	105	149	257	283	331	R357b	414	423G	435	428G	BL433b	TL441	451H			
44	78d	111a	150	259	284A	332a	358	415a	423H	435A	428H	BL433c	BL441	451I			
45	78e	111b	151	261	284B	332b	359	415b	423I	435B	428I	R433	R441a	453			
46	79	117	152	262-3a	284C	332c	360	415c	423J	435C	428J	434a	R441b	454			
47	80	119	153	263-3b	284D	333d	361	415d	423K	435D	428K	434b	442	455			
48	81	121a	154-5	263-3c	284E	332e	362a	416	423L	435E	428L	434A	442A	456			
49a	82	121b	156	265	285	332f	362b	417	434A	435F	428M	434B	442B	458			
49b	83	121c	157	267	286A	332g	363	418	434B	435G	429a	434C	443	462			
49c	84	121d	158	269	286B	332h	364	419	434C	435H	429b	434D	443A	463			
49d	85a	121e	159	271	286C	332i	365	420a	434D	435I	429c	434E	443B	464a			
49e	85b	121f	160	273	286D	335a	366	420b	434E	435J	429d	435	443C	464b			
49f	85c	121g	161														
138A	144A	146A	148C	148F	148I	308B	310C	312C	314A	318A	318D	320C	322A	322C			
142A	144B	148A	148D	148G	306A	310A	312A	312D	316A	318B	320A	320D	322B	322D			
142B	144C	148B	148E	148H	308A	310B	312B	312E	316B	318C	320B						

1	2	3	4	21	22	25	26	28	29	33	34	35	36	37	38	40	42	43
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
45	**46**	**47**	**48**	**49**	**50**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**61**	**62**	**63**	**64**	**65**
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Street: City: State:

Street: City: State:

(Card Expires October 1)

For PRODUCTS and SERVICES

not specifically advertised in this issue, consult your . . .

Chemical Engineering Inventory Issue

Published in Mid-September 1954, it is your annual guide to all major recent developments in . . .

CHEMICALS • EQUIPMENT • SERVICES

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NEEDED IF MAILED IN THE UNITED STATES

—4¢ POSTAGE WILL BE PAID BY—

CHEMICAL ENGINEERING
READER SERVICE DEPARTMENT
330 WEST 42nd ST.
NEW YORK 36, N. Y.

PLEASE TYPE OR PRINT

Name_____

Position_____

Company_____

Address_____

City & State_____

USE YOUR READER SERVICE FOR MORE INFORMATION ABOUT

- Advertised Products
- Product News
- Equipment News
- New Literature
- Reprints

. . . and even for

- Change of Address

Attention NON-SUBSCRIBERS:

Why be just another name on a magazine circulation list . . . when you can have your own copy of CE for less than a PENNY A DAY?

JUST A PENNY A DAY could have brought you the personal use of all the information in this issue. Just think . . . with your own copy of CHEMICAL ENGINEERING, there is no waiting for each issue to reach you and there is no need to hurry it along. You can clip articles for your files . . . the entire issue is yours, as personal as your newspaper.

Why wait? Use the handy coupon below to order your personal subscription to CHEMICAL ENGINEERING today!

No need to send any money now. We'll bill you later.

TO SUBSCRIBE:

1. How manymyears? →
2. About your company →
3. HOME mailing address if you prefer →

BE SURE TO FILL OUT OTHER SIDE OF CARD BEFORE MAILING

KEY NUMBERS Circle for more information about

- **ADS**
- **EQUIPMENT**
- **PRODUCTS**
- **SERVICES**
- **LITERATURE**

and

- **FLASHBACK ITEMS**

(See page 421)

TO ORDER REPRINTS

Indicate quantities for each

(See page 458)

FOR CHANGE OF ADDRESS (Give both old and new address)

Old → Address

New → Address

New Subscription Form:

Domestic Rates only. For all others, see p. 5 1 Year $3☐; 2 years $4☐; 3 Years $5☐

Product or service No. employees approx.

Street: City: State:

3	49g	85d	121h	162-3	273a	287	333b	367a	430c	434F	435K	439e	435A	443D				
6	50-1a	85e	123	164	273b	288A	333c	367b	430d	434G	435L	439f	435B	444				
8	50-1b	85f	125	165	273c	288B	334	367c	430e	434H	436	439A	436C	444A				
9	50-1c	85g	127	166	273d	288C	335	367d	430f	434I	436A	439B	435D	444B				
10	52	85h	129	167	274A	288D	336	368	431	434J	436B	439C	435E	445				
11a	53	85i	131	168	275	288E	337	369	432A	434K	436C	439D	435F	446				
11b	54	85j	133a	169	276A	290A	338	370	432B	434L	436D	439E	436G	446A				
11c	55	85k	133b	170	277	290B	339	371	432C	434M	436E	439F	435H	446B				
12	56	85l	133c	171	278A	290C	340	373a	432D	434N	436F	439G	435I	TL447				
13	57	87	133d	231a	278B	290D	341	373b	432E	434O	436G	439H	435J	BL447				
15	58	88	135	231b	278C	290E	343	374a	432F	434P	436H	439I	435K	R447				
19	59	89	137	231c	279a	292	344	374b	432G	434Q	436I	439J	436	448				
20-1	60-1a	90	140A	231d	279b	295	345	375	432H	434R	436J	430	436A	448A				
23-3	60-1b	91	141	233	279c	301	346	376	432I	434S	436K	430A	436B	TL449				
24	60-1c	92	143	235	279d	303	347	377	432J	434T	437	430B	436C	BL449				
25	60-1d	93	144A	237	279e	304	TL349	378	432K	434U	437A	430C	436D	R449				
29a	62	94–5	144B	239	279f	306	BL349	379	432L	434V	437B	430D	437	L450				
29b	63	96a	145a	241a	279g	307	R349	380	432M	434W	437C	430E	437A	R450				
29c	64	96b	145b	241b	279h	309	350	382a	432N	434X	437D	430F	437B	450A				
29d	65	96c	146A	241c	279i	311	TL351	382b	432O	434Y	437E	430G	437C	450B				
29e	66a	96d	146B	241d	279j	313	BL351	383	432P	434Z	437F	430H	438	450C				
29f	66b	97	147	241e	279k	314	R351	384	432Q	434AA	437G	L431	438A	450D				
29g	67	98	148A	241f	280A	315	352	387	432R	434BB	437H	TR431	438B	450E				
32-3	68	99a	145B	241g	280B	316	TL353	393	432S	434CC	437I	BR431	L439	L451				
34	69–70	99b	148C	241h	280C	317	BL353a	TL395	432T	434DD	437J	432	TR439	R451				
35–6a	71	99c	148D	242-3	280D	319	BL353b	BL395	433	434EE	438	432A	BR439	451A				
35–6b	73	99d	148E	247	281	324	R353	TR395	433A	434FF	438A	432B	440	451B				
35–6c	74–5	99e	148F	249	282A	325	354	BR395	433B	434GG	438B	432C	440A	451C				
37–40a	76	99f	148G	251	282B	326	TR355	TR396	433C	434HH	438C	432D	440B	451D				
37–40b	77	99g	148H	253	282C	328	BR355	BR396	433D	434II	438D	432E	440C	451E				
41	78a	101	148I	254–5a	282D	329	356	L397	433E	434JJ	438E	TL433	440D	451F				
42	78b	102	148J	254–5b	282E	330	R357a	413	433F	434KK	438F	BL433a	440E	451G				
43	78c	105	149	257	283	331	R357b	414	433G	435	438G	BL433b	TL441	451H				
44	78d	111a	150	259	284A	332a	358	415a	433H	435A	438H	BL433c	BL441	451I				
45	78e	111b	151	261	284B	332b	359	415b	433I	435B	438I	R433	R441a	453				
46	79	117	152	262-3a	284C	332c	360	415c	433J	435C	438J	434a	R441b	454				
47	80	119	153	262-3b	284D	332d	361	415d	433K	435D	438K	434b	442	455				
48	81	121a	154–5	262-3c	284E	332e	362a	416	433L	435E	438L	434A	442A	456				
49a	82	121b	156	265	285	332f	362b	417	424A	435F	438M	434B	442B	458				
49b	83	121c	157	267	286A	332g	363	418	424B	435G	439a	434C	443	462				
49c	84	121d	158	269	286B	332h	364	419	434C	435H	439b	434D	443A	463				
49d	85a	121e	159	271	286C	332i	365	420a	434D	435I	439c	434E	443B	464a				
49e	85b	121f	160	272	286D	333a	366	420b	434E	435J	439d	435	443C	464b				
49f	85c	121g	161															

138A	144A	146A	148C	148F	148I	308B	310C	312C	314A	318A	318D	320C	322A	322C
142A	144B	148A	148D	148G	308A	310A	312A	312D	316A	318B	320A	320D	322B	322D
142B	144C	148B	148E	148H	308A	310B	312B	312E	316B	318C	320B			

1	2	3	4	21	22	25	26	28	29	33	34	35	36	37	38	40	42	43
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
45	46	47	48	49	50	52	53	54	55	56	57	58	59	61	62	63	64	65
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Street: City: State:

Street: City: State:

(Card Expires October 1)

P.S. Did you miss anything in this issue? Here's a list to help you make a quick check:

Chementator 103

What's Happening in Chemical Engineering
- Catalysts 112
- Super Dry CO_2..... 120
- Sugar Diffusion.... 124
- PVC Polymerization 128
- Centrifuge 132

Chemicals & Raw Materials
- Acrylics for Paint.. 140
- Index 142

Feature Report
- A Lot of the Future 173
- Moving Bed Processes 175
- Operation 177
- Fundamentals .. 181
- Design 189
- Applications ... 198

Feature Articles
- Engineering Your Cost Reduction 207
- Plant Drives for Process Heat Balance 211
- Variable Speed for Process Control.... 215
- Rate Your Centrifugal Pumps—In Use.. 223

CE Refresher
- Interpretation of Kinetic Data—IV 227

Plant Notebook
- Automatic Delay for Burner Control.. 232
- Truck Transmission Drives Conveyor. 234
- Mark Charts for Normal Conditions 234
- Thermal Conductivity Chart for Gases. 236
- Aids for Pressure Drop Calculations 238
- How to Acidize a Water Well 240

You and Your Job
- How Does Your Salary Stack Up..... 244

Corrosion Forum
- Versatile New Alloy Now Available.. 256

Tomorrow's Technology
- Solids Drying..... 264
- Pebble Cooler..... 266
- Your Checklist.... 270

Equipment News
- New Non-Metallic Shapes 274
- Index 276
- Thermal Process... 278
- Cost Index..... 282

Chemical Economics
- Decentralization .. 294
- Consumption Index. 296
- Soda Ash Target... 298

Pictured Flowsheet
- Ammonium Nitrate—3 Process 320

Other Departments
- Advertisers Index.. 452
- Book Reviews..... 340
- Convention Calendar 134
- Firms in the News.. 346
- Man of the Month. 327
- Names in the News. 328
- Technical Literature 422
- Pro and Con..... 336
- Reader Service.... 467
- Recent Pamphlets.. 344

AND here is the Reader Service postcard that speeds more information to you.

FIRST CLASS
PERMIT NO. 64
(Sec. 34.9 P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

—4¢ POSTAGE WILL BE PAID BY—

CHEMICAL ENGINEERING
READER SERVICE DEPARTMENT
330 WEST 42nd ST.
NEW YORK 36, N. Y.

PLEASE TYPE OR PRINT

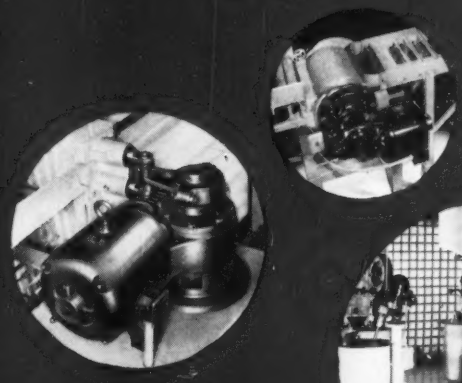
Name_____

Position_____

Company_____

Address_____

City & State_____



What do you need in your electric motor drives . . . gear reduction . . . electric brakes . . . variable speed operation . . . fluid drive . . . special mountings or does a standard motor (like the 200 HP synchronous motor shown below) best suit your needs? Whatever it is, check with Master first. We offer you the widest selection of electric motor drives in the nation.

In thousands and thousands of ratings, ⅛ to 400 horsepower . . . in open, enclosed, splash proof, fan cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 430 to 1 ratio . . . with either magnetic or dynamic type electric brakes . . . with fluid-drive . . . with mechanical or electronic variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best power drive for you.

it's easy to get the right results

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO



MASTER

ELECTRIC MOTORS

Corrosioneering News

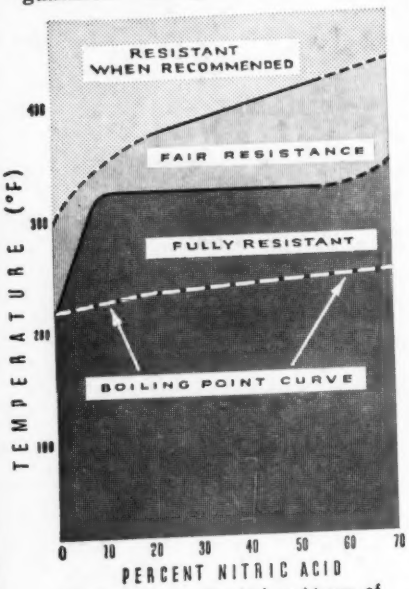
Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

NOW! Process HNO_3 in vessels *guaranteed* against corrosion!

Now you can have a year's free "vacation" from the expense of repairing or replacing equipment damaged by corrosion.

Pfaudler's exclusive one-year guarantee against corrosion is available on all acid-alkali-resistant glassed steel equipment for use with products on which field and laboratory data provide evidence of sufficient corrosion resistance. For example, a vessel for processing chemically pure 60% nitric acid solution at 300° F 24 hours a day, 365 days a year can be guaranteed for a full year, and will actually deliver excellent service for as many as 15 years or more!

Similarly, many other corrosives can be covered by the same type of guarantee – and glassed steel equipment can actually give you 5 to 15 years more service beyond the guarantee period.



This chart shows the high resistance of glassed steel processing pure nitric acid 24 hours a day, 365 days a year. This type of laboratory data is basis for Pfaudler's unusual corrosion guarantee.

Under the terms of the Pfaudler corrosion guarantee, you receive free on-the-spot inspection and repair service on your acid-alkali-resistant glassed steel vessel, should it be made inoperable by corrosion within one year after date of purchase. Factory repairs will be performed on an F.O.B. factory basis. Operating conditions covered by the guarantee are agreed upon at time of purchase.

A wide range of corrosives may now be processed in Pfaudler corrosion-guaranteed equipment. Agreements are being written for any acid or alkali solution for which laboratory tests indicate sufficient corrosion resistance.

Right now, you may have an expensive corrosion problem that can be cured by this unusual guarantee on equipment. Write for further information.

When should you use a rotary seal and when a stuffing box?

Some of our customers have run into situations that *demand* the protection of a rotary seal. For them, we have supplied mechanical seals with outstanding success. We have several mechanical seal designs available on Pfaudler glassed steel vessels, all of which give excellent results under specific service conditions.

But many of our customers face the problem of choosing between a seal and a stuffing box. With all the latest technical improvements, seals in many cases involve a greater expense than stuffing boxes. The question is–should you pay the extra cost, in order to get perfect sealing?

Cost vs. Sealing

There's no pat answer. To give you widest choice possible, Pfaudler offers mechanical seals as well as two types of stuffing boxes. For operating economy, the stuffing boxes are supplied with a Teflon ring which protects packing against corrosion, and increases protection of your product against contamination.

The high-duty stuffing box has a number of "plus features," including: automatic lubrication; a replaceable alloy sleeve for added corrosion protection; and a lantern ring that does double duty as a no-play bearing.

The low-duty stuffing box is economical where leakage is not a prime problem. Much smaller than the high-duty stuffing box, it uses a Teflon ring in the lowest position, to keep corrosive vapors from contacting the asbestos packing.

For help in selecting the type of seal that will best solve your problem, we suggest you consult your Pfaudler representative.



Equipment used for performing delicate hydrolysis at R.K. Laros Company.

In this business, he *dares not* risk corrosion!

Processing a blood volume expander with hydrochloric acid is a challenge to both methods and equipment.

On one hand you've got an acid that's sharply corrosive. On the other, you've a product that *must* be kept pure.

The Chemical Division at R. K. Laros Company uses the equipment you see here to do such a job. Twin glassed steel reactors perform the delicate hydrolysis. Supplied by Pfaudler, they resist attack by hydrochloric acid and provide a safe, pure product.

Whether you're looking for better corrosion resistance as a means of keeping your product free of contamination, or as a way to cut the cost of replacing equipment, you may be able to solve your problem with Pfaudler glassed steel.

Got a chemical project that is bothering you?

We are staffed and ready to help you or your consultants in working out the best combination of materials and equipment to attain desired yields. Why not check with us?

Pfaudler

THE PFAUDLER CO., ROCHESTER 3, N. Y.